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Detection and Estimation of Metanil Yellow & Congo Red: Carcinogenic Food Colourants, Present in Different Food Samples

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ABSTRACT

Nowadays adulteration is a social disease which is applied on food to make food more attractive and to gain more profit from it. Along with different processed food products, Spices like Turmeric powder, red chilli powder, etc. provides good nutrition to us until they are treated with some foreign colours or organic colours to make them adulterated, which causes various detrimental effects in physiological system such as heart failure, liver damage, cancer and many more, if people consume them over a certain period of time. Metanil yellow, Sudan red dye, Congo red are such organic dyes which are used abundantly in different spices and processed food products. These dyes are toxic chemicals and could be carcinogenic as well. The presence of all these components can be detected with chemical experiments. This present research study is focused on the detection of adulterants present in sample on the basis of pH variation of adulterated food sample from the pure one and its estimation by variation of spectrophotometric absorbance with the concentration of the adulterant in the sample. After testing samples with different concentration of adulterants, it has been observed that pH of samples is gradually increasing with the increase in concentration of adulterants from 0 to 16.66 gm/ 100gm present in the sample.

KEYWORDS: *Spectrophotometer, Metanil Yellow, Congo Red, pH, Colour Absorbance.*

I. INTRODUCTION

Day by day the number of food adulteration cases are increasing rapidly and as a result it's became a concern for food safety organizations to trace adulteration in many food materials like honey, Spices, oils, dairy and meat products. **[1]** Many spices like Turmeric have a history of their use for their medicinal value due to the presence of some chemical compound, (example - Curcumin for turmeric) **[2] [3] [4].** For a customer to buy any food product, the first impression is governed mainly by its visual aspect than what impact it has on health after consuming it. Hence the use of synthetic food dyes forms an integral part in food

industries as an additive to hide the improper conditions of processing and to ensure uniformity and increase its attractiveness in order to achieve financial gain. **[5]** Metanil yellow, a non-permitted synthetic toxic azo dye, is reportedly used in the adulteration of some food items like in laddo, besan and more significantly in turmeric powder produced by the organized and unorganized sectors **[6] [7] [8]**. An estimate says that out of 253 food samples that are tested, 58 of them i.e., 20.94% of total samples contain metanil yellow in which 63.79% of the metanil yellow positive samples contained adulteration above the maximum permissible limit i.e., above the 100 mg kg-1 food samples as specified in the Prevention of Food Adulteration Act of India (PFA, 2008). **[9]** Turmeric powder and red chilli powder has been evaluated with fourier transfer raman and fourier transfer infra-red spectroscopy to detect metanil yellow and congo red samples respectively in it at its lowest possible concentrations, it showed success at 1 and 5 % concentrations respectively. **[10]** The experimental values i.e., the absorbance values were observed from the Uv- Visible Spectrophotometer (**Model: V-630**). Metanil Yellow (MY) is a toxic and chief additive adulterant owing to its colour that ranges from yellow to orange and hence is majorly used in turmeric, pulses or sweets as per the colour requirement, in India. **[11]** Red chilli powder has a long history with congo red named hazardous azo dyederived from benzidine. which is used as adulterants and it has carcinogenic properties **[12] [13] [14].** Congo Red has harmful effect even in low concentrations**.** The harmful effect of azo dye chemicals on human health have been documented. **[15][16]** Metanil yellow named azo dye is made from diazotized metanilic acid and diphenylamine. **[17]**

Hence colorimetric evaluation calls for a successful way to detect metanil yellow in food samples.**[18]** In our study we have utilised double slit UV visible spectrophotometer which uses two beams of light: a reference beam and a sampling beam that passes through the sample. A spectrophotometer can compare the brightness of incident lights by wavelengths. **[19]**

I. II. METHODOLOGY

In the process, double beam UV visible spectrophotometer was used. Pure metanil yellow solution and pure congo red solution was made which was considered to correct the peak or for peak processing. Peak processing is done to achieve the highest peak or highest wavelength for the pure sample known as the absorbance peak.Absorbance (on the vertical axis) is just a measure of the amount of light absorbed. The higher the value, the more of a particular wavelength is being absorbed. After peak processing the samples with different concentrations of metanil yellow and congo red were tested for their espective absorbencies with respect to the peak absorbance. It has been observed that the colour of pure turmeric powder solution will change to magenta colour with the addition of HCL in the presence of metanil yellow (Adulterant) and simultaneously pH of adulterated turmeric powder will vary with pure turmeric powder. And its pH and colour will vary the concentration of metanil yellow. And the colour of pure red chilli powder solution will change to deep purple colour with the addition of HCL in the presence of congo red dye (Adulterant) and simultaneously pH of adulterated red chilli powder will vary with pure red chilli powder. And its pH and colour will vary the concentration of congo red dye.

Spectrophotometric test:

II.1 Reagents Required

- Distilled Water - 30 ml (for each test tube)
- Hydrochloric Acid (35% concentration) - 4 drops
- Metanil Yellow
- Turmeric Powder
- Congo red dye
- Red chilli powder

II.2 Apparatus Required

- Uv- visible Spectrophotometer, V-630
- Test Tube (6 pcs)
- Dropper
- Digital pH meter'

II.3 Preparation of Samples

II.3.1 TURMERIC POWDER AND METANIL YELLOW

Sample 1: (Blank solution)

0 gm Metanil yellow + 3 gm Turmeric Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

Sample 2:

0.1 gm Metanil yellow + 2.9 gm Turmeric Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

III. Sample 3:

0.2 gm Metanil yellow + 2.8 gm Turmeric Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

IV. Sample 4:

0.3 gm Metanil yellow + 2.7 gm Turmeric Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

V. Sample 5:

0.4 gm Metanil yellow + 2.6 gm Turmeric Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

VI. Sample 6:

0.5 gm Metanil yellow + 2.5 gm Turmeric Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

II.3.2 RED CHILLI POWDER AND CONGO RED DYE

I. Sample 1: (Blank solution)

0 gm Congo red + 3 gm red chilli Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

II. Sample 2:

0.1 gm Congo red + 2.9 gm red chilli Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

III. Sample 3:

0.2 gm Congo red + 2.8 gm red chilli Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

IV. Sample 4:

0.3 gm Metanil yellow + 2.7 gm red chilli Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

V. Sample 5:

0.4 gm Congo red + 2.6 gm red chilli Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

VI. Sample 6:

0.5 gm Congo red + 2.5 gm red chilli Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

II.4 Procedure for spectrophotometric test [20]

I. Cuvette is placed into the Spectrophotometer by filling it with blank solution to calibrate Spectrophotometer.

II. After that, the reading of all sample with different concentrations are taken.

III. Same procedure is attained for Sample 3, Sample 4, Sample 5, Sample 6.

IV The wavelengths of the maximum absorbance value is recorded.

pH Test:

II.5 Reagents Required:

- Distilled Water - 30 ml
- Metanil Yellow
- Turmeric Powder
- Red chilli powder
- Congo red dye

II.6 Apparatus Required:

- Digital pH meter
- Beaker
- Glass rod

II.7 Sample Preparation

II.7.1 **TURMERIC POWDER AND METANIL YELLOW**

1**. Sample 1: (Pure solution)**

0 gm Metanil yellow + 3 gm Turmeric Powder + 30 ml Distilled Water

2**. Sample 2:**

0.1 gm Metanil yellow + 2.9 gm Turmeric Powder + 30 ml Distilled Water

3**. Sample 3:**

0.2 gm Metanil yellow + 2.8 gm Turmeric Powder + 30 ml Distilled Water

4**. Sample 4**:

0.3 gm Metanil yellow + 2.7 gm Turmeric Powder + 30 ml Distilled Water

5**. Sample 5**:

0.4 gm Metanil yellow + 2.6 gm Turmeric Powder + 30 ml Distilled Water

6**. Sample 6:**

0.5 gm Metanil yellow + 2.5 gm Turmeric Powder + 30 ml Distilled Water

II.7.2 **RED CHILLI POWDER AND CONGO RED DYE**

1. **Sample 1: (Pure solution)**

0 gm congo red + 3 gm Turmeric Powder + 30 ml Distilled Water

2**. Sample 2:**

0.1 gm congo red + 2.9 gm red chilli Powder + 30 ml Distilled Water

3**. Sample 3:**

0.2 gm congo red + 2.8 gm red chilli Powder + 30 ml Distilled Water

4**. Sample 4**:

0.3 gm congo red + 2.7 gm red chilli Powder + 30 ml Distilled Water

5**. Sample 5**:

0.4 gm congo red + 2.6 gm red chilli Powder + 30 ml Distilled Water

6**. Sample 6:**

0.5 gm congo red + 2.5 gm red chilli Powder + 30 ml Distilled Water

II.8 Procedure for pH test:

I. Test Tube 1 is taken and pH is measured with digital pH meter

II. Similarly, pH of test tube 2, test tube 3, test tube 4, test tube 5, test tube 6 are measured and the values are recorded.

III. RESULTS & DISCUSSION

The first table contains the data of the concentration of adulterant i.e., Metanil Yellow added in Turmeric Powder and its corresponding pH. Similarly, the second table contains the data of absorbance of the changed pink to magenta colour from yellow colour on addition of HCL and the concentration of Metanil Yellow added in Turmeric Powder (**sample**). The third table is the data set of Concentration of Congo Red in Red Chilli powder and its corresponding pH values while on the other hand the fourth table comprises the data of absorbance of the changed blue colour on addition of HCL reagent and the concentration of Congo Red used in Red chilli powder (**sample**). The Total amount of sample taken was 3gm (pure) and gradually the adulterants were mixed in it according to the concentration data given in the following tables thereby maintaining a total weight of 3gm (pure sample+ adulterant). The amount of adulterants mixed in each of the pure samples are calculated in terms of per 100gm of the sample as shown below. The absorbance of all the samples is measured at a particular wavelength.

IV. CALCULATIONS

In 3gm of pure sample= 0.1gm adulterant is present

Therefore, in 100gm of pure sample= (0.1*100)/3= 3.33gm/100gm of pure sample, adulterant is present.

Similarly, the other data were calculated as shown in the tables.

TABLE 1:

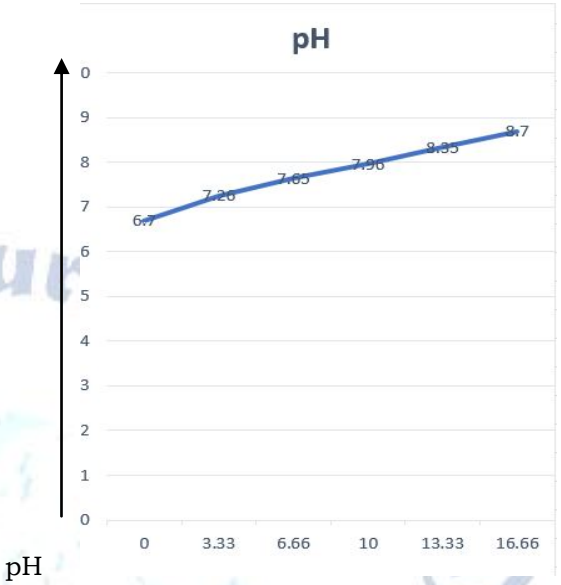
SAMPLE NO.	CONCENTRATION OF METANIL YELLOW IN TURMERIC POWDER (gm/100gm)	pH
1	0	6.7
2	3.33	7.26
3	6.66	7.65
4	10.0	7.96
5	13.33	8.35
6	16.66	8.7

TABLE 2:

The following data (absorbance) were observed in the wavelength of **515nm**.
Blank solution taken: 3.33gm of adulterated sample in 33.3ml Distilled water.

SAMPLE NO	ABSORBANCE (A)	CONCENTRATION OF METANIL YELLOW IN TURMERIC POWDER (gm/100gm)
1	3.1	3.33
2	4.4	6.66
3	4.5	10.00
4	4.6	13.33
5	4.78	16.66

CONCENTRATION OF METANIL YELLOW IN TURMERIC POWDER (gm/100gm) VS pH Graph



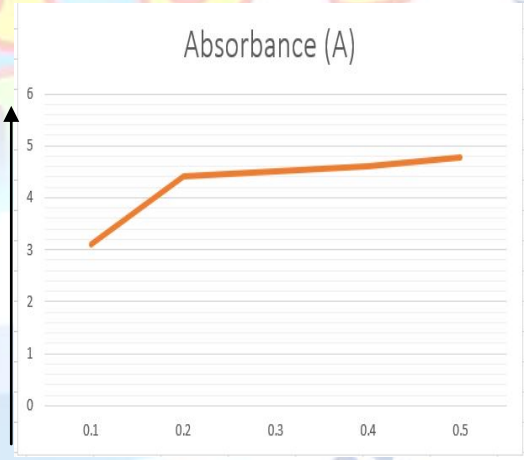
pH

CONCENTRATION OF METANIL YELLOW

TABLE 3:

SAMPLE NO.	CONCENTRATION OF CONGO RED IN RED CHILLI POWDER (gm/100gm)	pH
1	0	4.88
2	3.33	5.04
3	6.66	5.17
4	10.0	5.44
5	13.33	5.76
6	16.66	5.98

CONCENTRATION OF METANIL YELLOW IN TURMERIC POWDER (gm/100gm) VS ABSORBANCE GRAPH



ABSORBANCE

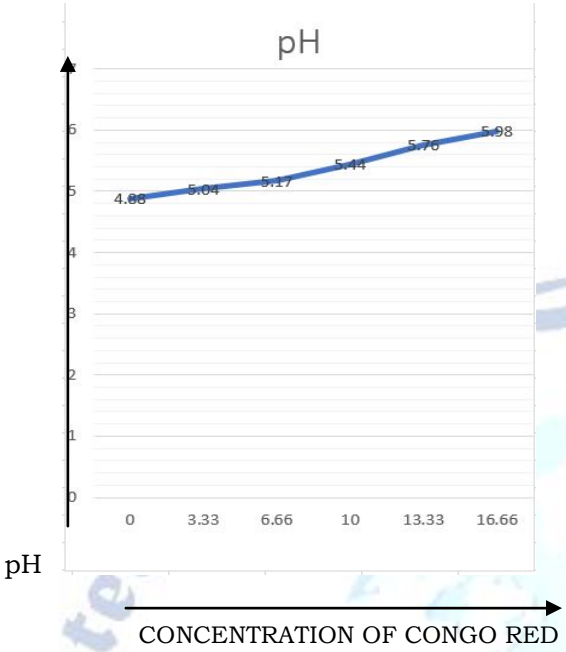
CONCENTRATION OF METANIL YELLOW

TABLE 4:

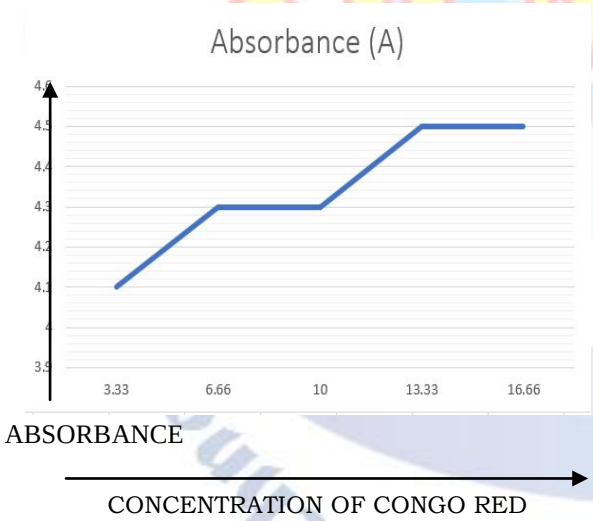
The following data (absorbance) were observed in the wavelength of **760nm**.
Blank solution taken: 3.33gm of adulterated sample in 33.3ml Distilled water.

SAMPLE NO	ABSORBANCE (A)	CONCENTRATION OF ADULTERANTS IN RED CHILLI POWDER (gm/100gm)
1	4.1	3.33
2	4.3	6.66
3	4.3	10.00
4	4.5	13.33
5	4.5	16.66

CONCENTRATION OF CONGO RED IN RED CHILLI POWDER (gm/100gm) VS pH Graph



CONCENTRATION OF CONGO RED IN RED CHILLI POWDER (gm/100gm) VS ABSORBANCE GRAPH



V. CONCLUSION

Undoubtedly Metanil Yellow and Congo Red are toxic, carcinogenic dyes which is used as an additive and food colorant. Its presence reduces the nutritional value of turmeric powder which is indeed a daily essential need. Despite of being known as a harmful food colorant, it is widely used in many food products as mentioned earlier and greatly affects human health. This research study shows how the value of colour absorbance and pH of an adulterated sample varies with the concentration of Metanil Yellow added in pure turmeric powder and Congo Red in pure Red chilli powder. The aim of this research study is to make common people aware of the harmful adulterants that are being used in various food products that are being consumed on a daily basis. It is being clearly understood that how the pH and absorbance varies with the concentration of adulterants added in pure turmeric powder.

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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.

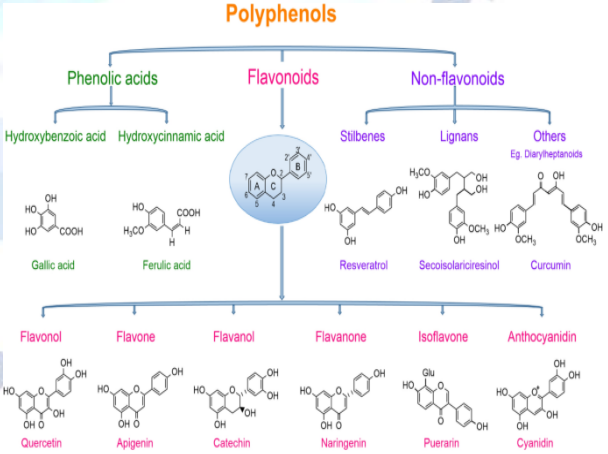
- The hydrolysis of glycosidic linkages.
- Formation of brown insoluble compound consisting of polyphenolic structure.

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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Detection Methods of Non-permitted Food Color, Metanil Yellow: A Review

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ABSTRACT

Food adulteration is a primary global concern for public health, especially in developing countries, due to the lack of monitoring and appropriate policy developments and executions. Due to its high demand in international trade, turmeric (Curcumina Longa) is subjected to economically motivated chemically unsafe adulteration, namely metanil yellow. Metanil yellow (3-4)-anilinophenylazo) benzene sulfonic acid sodium salt), is a hazardous dye and a common adulterant used in turmeric powder and other yellow colored food products. The toxic chemical travels in blood and reaches various organs and interferes with various cellular metabolic processes there. Our earlier studies reveal that metanil yellow generates oxidative stress in various vital organs such as heart, liver, and kidneys. As per the guidelines of food quality some conventional methods are used but these techniques possess various limitations. This study aims to review the use of FT-Raman and FT-IR spectroscopy for evaluation of metanil yellow in turmeric powder.

KEYWORDS: *Non-permitted food colors, metanil yellow, turmeric powder*

INTRODUCTION

There are several types of dyes used as food additives and food colorants. Metanil yellow is a yellow dye used extensively as a food colorant. It is made from diazotized metanilic acid and diphenylamine [1]. Azo dyes are also used in laboratories as biological indicators. Turmeric (Curuma long L.) is an appetizing root commonly used for food seasoning and for medicinal purposes. Turmeric has a long history of medicinal use in Asian countries (Reema F Tayyem et al. Nutr Cancer. 2006[2]) and is used in root, oil, and powder forms. Its medicinal value is mainly due to its content of curcumin (diferuloyol methane) (T Osawa et al. Biosci Biotechnol Biochem. 1995 Sep [3]) with attributed medical properties including anti-inflammatory, anticarcinogenic, antioxidant,and wound-healing effects(B Joe et al. Crit Rev Food Sci Nutr. 2004[4]). Curcumin has also been reported to have promise for development of therapies for Alzheimer's disease (Tsuyoshi Hamaguchi et al. CNS Neurosci Ther. 2010 Oct [5]).

According to the sources it has shown that the nutrient and acidity content in soil, fertilizer, soil type and cultivar affects the curcumin content in turmeric. Reported curcumin concentrations in turmeric range from 0.3% to 8.6% [3,6-9]. Curcumin is isolated from turmeric for medicinal and cosmetic purposes. Although whole, dried, or fresh turmeric are mostly free of contamination, turmeric powder can be deteriorated with different chemical powders used as substitutes for curcumin (Sasikumar.B et al. 2004 [10]). It has been using in many unorganized

sector such as in local sweet shops and marketed in the rural areas in West Bengal, India [11]. And the lost vital fact is it has been declared under the act prevention of food adulteration of India (2008) that presence of metanil yellow is over permissible limit [12]. Metanil yellow (C18H14N3NaO3S) is a toxic azo dye that has been added to turmeric powder to mimic the appearance of curcumin [12,13,14]. But the actual content of circumin is very low [15]. Toxicologically, metanil yellow is classified as a CII category substance by the Joint FAO/WHO Expert committee on Food Additives, and it inferred that it is a compound for which virtually no information on long-term toxicity is available(L P Srivastava et al. Environ Res. 1982 Feb[16]). A variety of conventional methods have been effectively used for detection of metanil yellow in food stuffs. Ion-pair liquid chromatography detected with 99% linearity the presence of azodyes, such as metanil yellow, in the range of 0.05 ppm to 10 ppm in food (Ming-Ren Fuh et al. Talanta. 2002[17]). Clearly, the relative value of optical methods has putten the increasing use for safety and quality detection of foods and sub-products. This study made use of FT-Raman and FT-IR spectroscopy for evaluation of metanil yellow in turmaric powder. Analysis expressed that the FT-IR method could detect the metanil yellow at the 5% concentration, while the FT-Raman method resulted to be more sensitive and could detect the metanil yellow at the 1% concentration (Sagar Dhakal et al. Foods. 2016 [18]). Relationships between metanil(yellow) spectral peak intensities and metanil yellow concentration were established using picturisation peaks at FT-Raman 1406 cm−1 and FT-IR 1140 cm−1 with correlation coefficients of 0.93 and 0.95, respectively (Nathalie Mainreck et al. J Pharm Sci. 2011 Feb[19]).Although FT-IR and FT-Raman spectroscopy have not been previously reported for detection of metanil yellow adulteration in food, these spectroscopy methods have been widely used for detection of other food adulterants. Our paper on this review is meant for abstracting the various evil effects on human health due to utilisation of metanil yellow as food colorant or additive by human beings, This study also presents a comprehensive study of FT-Raman and FT-IR spectra of metanil yellow at different concentrations.

EFFECTS ON HUMAN BODIES

Utilization of metanil yellow in food can or may affect our nervous system and cause brain damage. Studies show that exhibition to metanil yellow terminates adult as well as developing brain in Wistar rats [20]. It was found that amine levels (neurotransmitters) in certain areas of brain such as the stratum and brain stem were markedly effected with oral administration of metanil yellow. Such changes were observed in hypothalamus also. After withdrawal of metanil yellow administration, the adverse changes in levels of neurotransmitters were not reversed [20]. Research shows that metanil yellow causes gastic problems and damages the intestine Metanil yellow also caused erosion and degeneration of gastric glands. In the intestine, it was observed that metanil yellow exposure loosened the structural configuration of absorptive columnar epithelial cells. Intestinal microvilli were also declared to be unsettle heavily due to metanil yellow exposure. All those caused loss of absorption capacity of nutrients [21]. Studies in fish model shows that extensive degeneration of cytoplasm, pyknosis of nuclei and damage occurred in central vein region of liver tissue on metanil yellow exposure.[21]

METHODS

1. FT-Raman and FT-IR Spectroscopy

The FT-IR module consisted of a triglycine sulfate (DTGS) detector with KBr beam splitter for collection of sample spectra in the spectral range of 650 cm−1 to 4000 cm−1. The attenuated total reflection (ATR) technique was utilized for FT-IR spectral collection. A small amount of the sample was placed on the Germanium crystal of the ATR device pressurized by pointed tip to ensure uniformity in surface area of contact between the Germanium crystal and sample. A background spectrum was first acquired with the empty Germanium crystal prior to spectral collection of the sample. The crystal plate and pointed pressure tip of the ATR device was cleaned thoroughly using cotton soaked with methanol after spectral acquisition of each sample. An average of 32 successive scans at 4 cm−1 intervals were acquired and saved (“comma separated values” format) for further analysis. The FT-IR spectral signal of three replicate samples were acquired at each concentration level [18].

RESULTS AND DISCUSSIONS

By looking at the structure of both metanil yellow and turmeric we found out that due to extended conjugation in degree responsible for the yellow color present in them. With concentration. The experimental spectral regions mostly show

uniqueness to each component, and preferably with the highest relative intensity, can be used to accurate projection the presence of metanil yellow in turmeric.

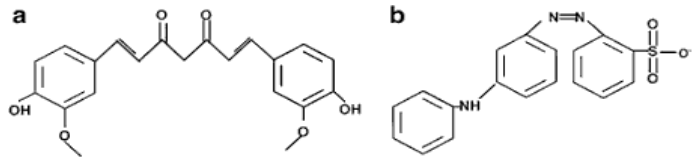
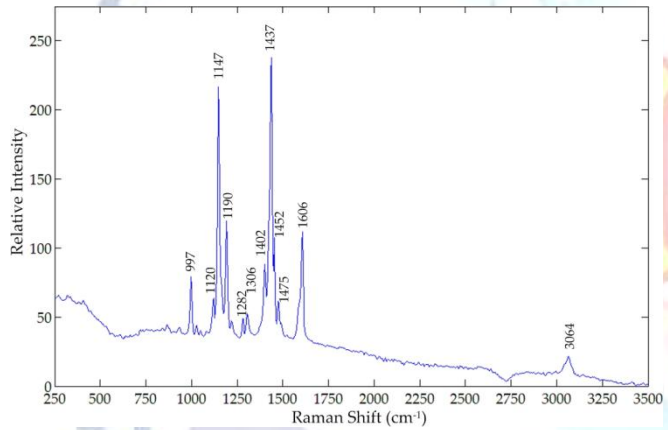
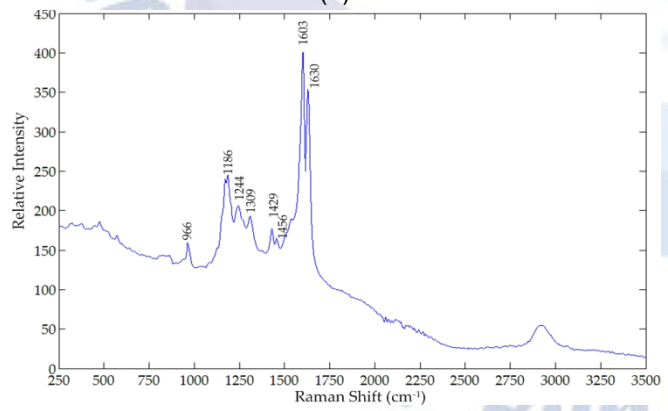


Figure 1 - structure of Metanil Yellow(b), turmeric(a)

As by looking at the structure of both metanil yellow and turmeric in figure 1[26], they both are different and dissimilar and the vibrational modes specific to precisely their slietly different chemical structures. Because we didn't have the device to confirm the actual readings and results, so the results and data are totally collected as because of the courtesy of [18]. so that we can show exact showcase of this evidence.



(a)



(b)

Figure: - FT-Raman spectra of: (a) Metanil yellow; (b) Turmeric powder

CONCLUSION

From the above study, it can conclude that rapid color test and thin layer chromatography can be used as a preliminary test for the detection of adulterants for metanil yellow. For further confirmatory study the analytical tests are performed, using the method of FT-Raman and IR-spectroscopy. In the recent years, synthetic yellow food colors are frequently used in different varieties of food item to make them more attractive to the consumers. The ornamental value thus reduces the qualitative value of the food. In such a scenario, the adulterant imposes serious threats to human leading to severe diseases like cancer. Also, in general cases it alters the normal functioning of the body. Advanced studies have also showed that FT-Raman and FT-IR spectroscopy has been effective in detecting mentanil yellow, turmeric and curcumin. FT-Raman method was able to detect 1% concentration of metanil yellow and FT-IR method was able to detect 5% concentration. Thus, both were developed to detect the peak values of metanil yellow as well using the band ratio model. Thus, this method has been considered as a boon to mankind as it detects carcinogenic metanil yellow in turmeric.

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Food and medicinal properties of hibiscus (*Hibiscus sabdariffa* & *Hibiscus rosa-sinensis*).

Propiedades alimentarias y medicinales del hibiscus (*Hibiscus sabdariffa* & *Hibiscus rosa-sinensis*).

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ABSTRACT

This study is based on the cultivation and scope of Hibiscus species, namely, Hibiscus rosa-Sinensis and Hibiscus sabdariffa. The objective was to find out the history of the production of Hibiscus, usage in different centuries, the most suitable regions for cultivation in India, various nutritive content, different health-related properties and benefits, new products that had been introduced, and abstract on what future may hold for the flowers. The study contains information on the antimicrobial, antioxidant, anti-cancerous properties along with several benefits like hypolipidemic effect, blood pressure-lowering effect, anti-diabetic activity, effect on lipid metabolism, antihypertensive effect, etc on the concerned flower. We have looked into the limitation of the flower, the need for urgent preservation methods to extend the shelf life of the product. As per our findings roselle leaves are used for their, antimicrobial, emollient, antipyretic, diuretic, anti-helminthic, sedative properties and as a soothing cough remedy.

Keywords: Hibiscus, Malvaceae, antimicrobial, hypo-lipidemic, candies, roselle, mesta.

RESUMEN

Este estudio se basa en el cultivo y alcance de las especies de Hibiscus, a saber, Hibiscus rosa-Sinensis e Hibiscus sabdariffa. El objetivo era averiguar la historia de la producción de hibisco, el uso en diferentes siglos, las regiones más adecuadas para el cultivo en la India, varios contenidos nutritivos, diferentes propiedades y beneficios relacionados con la salud, nuevos productos que se habían introducido y resumen sobre qué futuro puede depararles a las flores. El estudio contiene información sobre las propiedades

antimicrobianas, antioxidantes y anticancerígenas junto con varios beneficios como el efecto hipolipemiante, el efecto reductor de la presión arterial, la actividad antidiabética, el efecto sobre el metabolismo de los lípidos, el efecto antihipertensivo, etc. en la flor en cuestión. Hemos investigado la limitación de la flor, la necesidad de métodos de conservación urgentes para prolongar la vida útil del producto. Según nuestros hallazgos, las hojas de jamaica se utilizan por sus propiedades antimicrobianas, emolientes, antipiréticas, diuréticas, antihelmínticas, sedantes y como remedio calmante para la tos.

Palabras clave: Hibiscus, Malvaceae, antimicrobiano, hipolipemiante, caramelos, jamaica, mesta.

INTRODUCTION

Plants and plant products have been the subject of increased research in recent years. Plants with some historic therapeutic uses are being investigated more thoroughly in this area in order to be considered as a replacement or better alternative for chemical-based food preservatives. Plants are also a great source of natural inhibitors, and they can be used in the food industry as dietary supplements or as a natural inhibitor to protect the quality and extend the shelf life of goods. (Tiwari et. al., 2009).

Traditionally, various plants and their products have been used in foods as a natural preservative, flavoring ingredient, and as a treatment for a variety of human illnesses. Their antibacterial properties are primarily responsible for this property of action. Natural plant-derived antimicrobials are frequently particularly efficient in lowering antibiotic reliance, minimizing the likelihood of antibiotic resistance in foodborne infections, and facilitating dominant cross-contamination by foodborne pathogens (Voon et al. 2012)

Hibiscus is a blooming plant that belongs to the Malvaceae family. The genus is large, with hundreds of species native to temperate, semitropical, and tropical climates around the world. Member species are notable for their enormous, beautiful flowers, and are frequently referred to as "hibiscus" or "rose mallow," respectively. Several species, including Hibiscus syriacus and Hibiscus rosa-sinensis, are frequently cultivated as decorative plants. Hibiscus has a total of 679 species worldwide. Hibiscus rosa-sinensisand Hibiscus sabdariffa are the two most important species. Hibiscus plants defend themselves against radical violet exposure by manufacturing antioxidative phenolic resin compounds and flavonoids in plant tissues.

The Malvaceae family includes *Hibiscus sabdariffa*, sometimes known as "red sorrel" or "roselle." It is a well-known, safe medicinal plant with over 300 species found in tropical and subtropical locations like India, Saudi Arabia, Malaysia, Indonesia, Thailand, Philippines, Vietnam, Sudan, Egypt, and Mexico are among the countries involved. (Mohagheghi. M., et. al., 2005). Roselle blooms are mostly grown for human use, with Egypt, Sudan, Mexico, Thailand, and China being the top producers. Organic acids such as citric, malic, tartaric, and allo-hydroxy citric acids are abundant in roselle. Beta carotene, vitamin C, protein, and total sugar are all found in the plant (Mady, C. et. al., 2009). Roselle is well-known for its nutritional and therapeutic benefits, as it contains a variety of medically essential substances known as phytochemicals. Many parts of the Roselle plant, including seeds, leaves, fruits, and roots, are utilized in cuisine and herbal medicine as a non-pharmacological therapeutic option. Roselle extracts are used to treat a wide range of medical problems, including heart disease, helminthic disease, and cancer. The plant is also an antioxidant and is used to treat obesity.

In the ancient Indian *Hibiscus, rosa-ainensis* has been reported medicinal literature with a beneficial effect in heart disease (Ames, B.N., 1998). In recent times both experimental and clinical studies have shown that the dried powder of HRS has significant effectiveness against ischemic heart disease(IHD). In respect to the present knowledge of the physiology of IHD, the exact mechanism of its cardioprotective effects is not well investigated. In India Pink-Red Hibiscus rosa-Sinensis are very common. Hibiscus flower preparations are used for hair care. In Pacific Island, the flowers themselves are edible and are used in salads. In India, these flowers are used to shine shoes. It is also a pH indicator. China rose indicator turns basic solutions to green and acidic solutions to magenta/dark pink. Hibiscus rosa-Sinensis is also employed in Goddess worship, and the red species, in particular, plays a key role in tantra. Hibiscus rosa-Sinensis are called "kembang sepatu", in Indonesia which means "shoe flower". In Chinese herbology, it is considered to have several medical uses.

CULTIVATION IN INDIA

Mesta (*Hibiscus sabdariffa*) is cultivated in an area of about 1.5 lakh hectare. The crop has an average national productivity of 11q/ha. According to CRIJAF, its productivity has increased two folds since independence, despite facing tough competition from cheaper synthetic fibers. It is one of the important bast fiber crops which stand next to jute in

production. At the time of partition, India had to lose about 80% of the total jute production area. A particular set of climatic conditions is necessary for the production of jute crop, hence, the cultivation of jute could not be extended beyond the states of West Bengal, Assam, Bihar, Orissa, U.P., and Tripura. Consequently, the production of jute fell below the requirement of mills. Still, Mesta can be grown even in those areas where jute is not grown under wider soil and climate conditions with less care. This helped the country to inflate more area under Mesta.

In India, it is grown in larger parts covering areas from Karnataka to Tripura including Maharashtra, Andhra Pradesh, West Bengal, Bihar, Orissa, and Meghalaya. In Meghalaya and Tripura, it is grown in highlands either as a pure crop or in a mixture of rice. In Bihar and West Bengal, it is grown in sandy to sandy loam marginal lands. It is grown in the hilly districts of Koraput and Kalahandi, in Orissa. Andhra Pradesh has the maximum area under Mesta in India.

COMPOSITIONS

Roselle or Mesta (*Hibiscus sabdariffa*) is mainly cultivated for its calyx, which is of three types: green, red, and dark red (Naturland e.V Organic Farming in Tropics and Subtropics Exemplary Description of 20 Crops, 2004). The red calyxes are mostly used and are characterized by their anthocyanin concentration. Delphinidin 3-Sambubioside and Cyanidin3-Sambubioside are the major anthocyanins. *Hibiscus sabdariffa* is also rich in organic acids, minerals, amino acids, carotene, vitamin C, and total sugar in its calyx, leaves, and seeds at variable levels depending on the geographical area and the variety. According to a study by Manita–Mishra in 1992, many compounds have also been isolated and characterized from Roselle including flavonoids, anthocyanidins, triterpenoids, steroids, and alkaloids. Nutrient contents per 100 gram of different parts of Hibiscus sabdariffa are clearly stated in Table 1.

Table 1: Nutritional Composition

Nutrients	Calyxes	Seeds	Leaves
Protein(g)	2	28.9	3.5
Carbohydrate(g)	10.2	25.5	8.7
Fat(g)	0.1	21.4	0.3
Vitamin A (I.E)	-	-	1000
Thiamine(mg)	0.05	0.1	0.2
Riboflavin(mg)	0.07	0.15	0.4
Niacin(mg)	0.06	1.5	1.4
Vitamin C (mg)	17	9	2.3
Calcium(mg)	150	350	240
Iron(mg)	3	9	5

PRODUCTION OF MESTA (*Hibiscus sabdariffa)* FROM FY 2014 TO FY 2019 IN INDIA

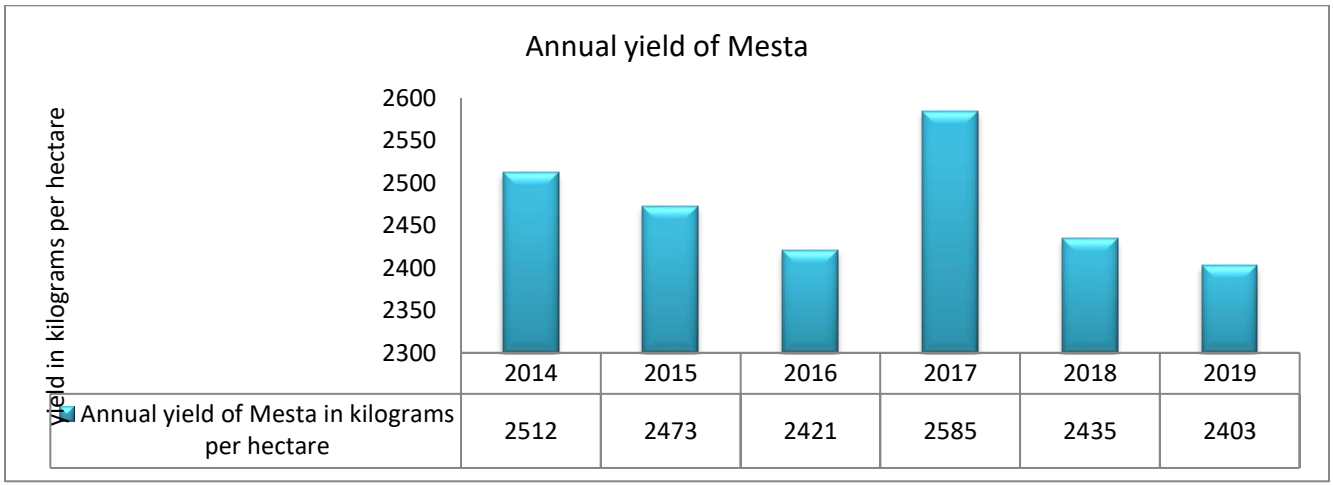

Fig 1: 2014-2019 production of mesta[7](Statista Research Department, 2020)

DIFFERENT MEDICINAL PROPERTIES

Roselle is well-known for its antibacterial, antifungal, and anti-parasitic actions. Oil extracted from seeds of Roselle has been shown to have an in vitro inhibitory effect on *Bacillus anthracis* and *Staphylococcus albus* (Gangrade, H. et. al., 1979). Schistosomamansoni and other bacteria were also shown to be resistant to aqueous and ethanol extracts. The antibacterial action of hibiscus extract against Streptococcus mutans, an oral cavity bacterium, was demonstrated by Afolabi, O.C., 2008. Antibacterial potential of

hibiscus was also observed on Campylobacter species, in similar studies. Aflatoxin formation gets reduces by an ethanol extract of the dried leaves of Roselle and has an in-vitro inhibitory effect against some fungi (El-Shayeb, N.M. and Mabrook, S.S., 1984).

Antimicrobial properties: Roselle is commonly used to cure a variety of ailments. Olaleye (Olaleye, M.T., 2007) used the aqueous methanolic extract of Roselle and reported that the extract contained cardiac glycosides, flavonoids, saponins, and alkaloids. It exhibited antibacterial activities against *Staphylococcus aureus*, *Bacillus stearothermophilus, Micrococcus luteus*, *Serratia mascences*, *Clostridium sporogeneses, Escherichia coli*, *Klebsiella, pneumoniae, Bacillus cereus, Pseudomonas fluorescence.* The findings supported traditional medicine's usage of the Roselle plant to treat abscesses, bilious disorders, cancer, and coughs, as well as the prospect of isolating antibacterial and anticancer compounds when testing antimicrobial activity against Escherichia coli O157:H7. Fullerton (Fullerton, M. et al., 2011) found that Roselle extract was effective against *Salmonella enterica* and *Listeria monocytogenes* isolated from food, veterinary, and clinical samples, suggesting that extracts could be used as potential antimicrobials in foods. The bactericidal activities of Roselle calyx aqueous and ethanol extracts, as well as protocatechuic acid, on *Salmonella Typhimurium DT104*, *E. coli O157:H7, Listeria monocytogenes, Staphylococcus aureus, and Bacillus cereus* were estimated by Chau, et al. in 2008 and shown that the inhibitory activity in dose-dependent behavior against test bacteria in ground beef and apple juice and suggested that it might be potent agents as food additives for preventing contamination from those bacteria.

Antioxidant properties: Roselle-Hibiscus anthocyanins (HAs), a group of natural pigments present in the dried calyx, were discovered to have antioxidant activity and liver-protecting qualities. HA antioxidant bioactivity in rat primary hepatocytes and hepatotoxicity was studied by Wang, C.J. et. al., in the year 2000. The results revealed that HA's, at the concentrations of 0.10 mg/ml and 0.20 mg/ml, significantly decreased the leakage of lactate dehydrogenase and the formation of malondialdehyde and the serum levels of hepatic enzyme markers (alanine and aspartate aminotransferase) decreased and reduced oxidative liver damage. The antioxidative activity was also reported in cancerous cell lines (Akim, A. et. al., 2011). McKay et. al., in the year 2010, reported in their animal models that extract of Roselle’s calyces have demonstrated hypocholesterolemia and antihypertensive properties. The antioxidant potential of three fractions of the ethanol crude extract discovered in the dried flowers (HS-C: chloroform soluble fraction; HS-E: ethyl acetate soluble fraction; HS-R: residual fraction) were assessed for their ability to quench

free radicals and inhibit xanthine oxidase (XO) activity (Tseng, T.H. et. al., 1997). HS-E had the best ability to scavenge free radicals, while HS-C had the most potent inhibitory effect on XO activity. Furthermore, antioxidant bioactivities of these crude extracts were investigated on rat primary hepatocytes. Unscheduled DNA Synthesis was found to be strongly inhibited by all portions (UDS). According to these findings, dried floral extracts (HS-C and HS-E) protect rat hepatocytes from t-BHP-induced cytotoxicity and genotoxicity. Lactate Dehydrogenase (LDH), Glutamate Oxalate Transaminase (GOT), Glutamate Pyruvate Transaminase (GPT), and Malondialdehyde (MDA) levels were greatly elevated, while Superoxide Dismutase (SOD) and Glutathione levels were significantly lowered. The effects of hepatoprotective and antioxidant compounds on carbon tetrachloride (CCl4)-induced liver damage were investigated (Yin, G. et. al., 2011).

Anti-cancerous properties: In 2011, Akim, A. et al. investigated the antiproliferative properties of Roselle juice using ovarian (Caov-3), breast (MCF-7, MDA-MB-231), and cervical (HeLa) cancer cell lines and discovered that it had the greatest antiproliferative capability against MCF-7 cancer cells. The effects of Roselle-anthocyanins (HA) on human cancer cells (HL-60) were investigated, and apoptosis of cells was seen in a dose and time-dependent way (Chang, Y.C. et. al., 2005). In 2005, Hou, D. et al. found that anthocyanin-induced apoptosis of leukemia cells was mediated by reactive oxygen species-mediated mitochondrial pathways. PCA, a phenolic compound isolated from the dried flower, was reported to reduce retinoblastoma phosphorylation and downregulate Bcl-2 protein expression, causing apoptosis in human promyelocytic leukaemia (HL-60) in a concentration and time-dependent manner (Tseng, T.H. et. al., 2000). The study revealed that cells underwent intramucosal DNA fragmentation and morphological changes characteristics of apoptosis while the action against gastric carcinoma cells by inducing apoptosis was through JNK/MAPK signaling pathways (Lin, H. et. al., 2007). The methanolic extract of Roselle on seven cancer lines implied the AGS cancer cells being most susceptible in concentration-dependent form affecting both the intrinsic and extrinsic apoptotic routes (Lin, H. et. al., 2005). Mohamed, R. et. al., in 2005, reported that the antioxidant potential of Roselle (Hibiscus sabdariffa L.) extracts was studied. Different plant organs, including seeds, stems, leaves, and sepals, were analyzed concerning their water-soluble antioxidant capacity, lipid-soluble antioxidant capacity, and tocopherol content. The Roselle plant's seeds are abundant in lipid-soluble antioxidants, especially -tocopherol. Its seed oil was extracted and analysed, yielding the following physicochemical results: acidity of 2.24 percent, peroxide index of 8.63 meq/kg, and extinction coefficients of 3.19 and 1.46 at 232 (k232) and 270 (k270), respectively. 15.53 hours of oxidative stability; 1.477 refractive index; 0.92 kg/L density;

and 15.9 cP viscosity Roselle seed oil is classified as linoleic/oleic, with the most prevalent fatty acids being C18:2 (40.1%), C18:1 (28%), C16:0 (20%), C18:0 (5.3%), and C19:1 (1.7 percent). -sitosterol (71.9%), campesterol (13.6%), -5-avenasterol (5.9%), cholesterol (1.35%), and clerosterol (1.35%) are all sterols (0.6 percent). Total tocopherols, comprising -tocopherol (25 percent), -tocopherol (74.5 percent), and -tocopherol (74.5 percent), were found at an average concentration of 2000 mg/kg (0.5 percent). Roselle seed oil's overall qualities imply that it could have significant industrial applications, in addition to the traditional usage of Roselle sepals in the preparation of karkade drink.

HEALTH BENEFITS OF HIBISCUS

Roselle is used in many folk medicines. Its mild laxative action, capacity to stimulate urine, relief during hot weather, and treatment of cracks in the feet, bilious, blisters, and wounds have all made it popular. Roselle has been used to cure sour throats and sores in Sudan for ages. In African folk medicine, Roselle leaves are used for their, antimicrobial, emollient, antipyretic, diuretic, anti-helminthic, sedative properties and as a soothing cough remedy, whereas in India, leaves are poultice on abscesses.

Hypolipidemic effects: Two capsules of Roselle extract (1g) administered three times a day (for a total of 3g/day) dramatically reduced blood cholesterol in hypercholesterolemic patients, according to a study (Lin, Tzu-Li. Et. al., 2007) Another scientific study found that an ethanolic extract from Roselle leaves has a substantial hypolipidemic impact. Roselle extract was also evaluated in a group of people who had and didn't have metabolic syndrome. The ethanolic extract of Roselle dramatically lowered hyperglycemia, total cholesterol, and low-density lipoprotein while raising high-density lipoprotein in metabolic syndrome patients.

Blood pressure lowering effect: The effectiveness of an aqueous extract of Roselle on mild to moderate hypertension was investigated in many types of research. Aqueous extract of Roselle was as effective as captopril in treating mild to moderate hypertension and there is no adverse effect with the treatment, confirming the effectiveness and safety of the extract (Herrera-Arellano, A. et. al., 2007) Even though the possible mechanism(s) of action of Roselle extract is not investigated, daily consumption of an aqueous Roselle extract resulted in a decrease in systolic and diastolic blood pressure (Haji-Faraji & Haji-Tarkhani 1999).

Anti-diabetic activity: 27 The polyphenolic components of Roselle were extracted and their effects were examined in a type II diabetic rat model (high-fat diet model). Studies revealed anti-insulin resistance properties of extract at a dose level of 200mg/kilogram and reduction in hyperglycemia and hyperinsulinemia. The extract was found effective in lowering serum cholesterol, triacylglycerol, the ratio of low-density lipoprotein/high-density protein (LDL/HDL), and also (AGE) formation and lipid peroxidation. Intestinal α-glycosidase and pancreatic α-amylase help in the digestion of complex carbohydrates present in the food into bioavailable monosaccharide and plays an important role in postprandial hyperglycemia; As a result, inhibiting these enzymes has been suggested as a viable method for controlling postprandial hyperglycemia. Hibiscus acid (hibiscus-type (2S,3R)-hydroxy citric acid lactone) has been demonstrated to be a powerful inhibitor of pancreatic-amylase and intestinal-glucosidase activity, as well as pancreatic-amylase activity (Yamada, T. et. al., 2000). In another study, conducted an in vitro study and reported Roselle extracts as an effective inhibitor of pancreatic α-amylase (Adisakwattana, S. et. al., 2012).

Effect on lipid metabolism: The effect of Roselle on lipid profile, creatinine, and serum electrolytes was studied in hypertensive patients, and it was found that the increased trend of total cholesterol and High-Density Lipid (HDL) is noteworthy, as HDL-Cholesterol is a preventive factor for coronary heart disease. The changes in urine in normal patients after consuming Roselle juice in various concentrations and durations reported a decrease in creatinine, uric acid, citrate, tartrate, sodium, calcium, phosphate, and potassium, but not oxalate in urinary excretion, which may aid in the treatment and prevention of renal stone disease.

Antihypertensive effect: Hypertension is currently recognized as a global health problem since it is linked to the development of cerebrovascular disorders, heart ischemia, and cardiac and renal failure. In 1999, Haji-Faraji & Haji-Tarkhani reported that the efficacy of the aqueous extract in hypertensive people revealed a substantial reduction in systolic and diastolic pressure differences when compared to the control group. Another study found that while systolic pressure decreased significantly, diastolic pressure remained the same. Rat studies were also carried out, and the results backed up the prevalent idea that Roselle extract contained antihypertensive components. (Onyenekwe, P.C. et. al., 1999). The anthocyanins extract was tested in humans for therapeutic efficacy, safety, and tolerability alongside the antihypertensive drug captopril (Odigie, I.P. et al., 2003) and lisinopril. The results were similar, implying that the synergistic mechanism of diuretic and ACE inhibition

results in hypotensive effects (Herrera-Arellano, A. et. al., 2004; Herrera-Arellano, A. et. al., 2007)

Other uses of Roselle/Mesta: A strong fiber obtained from the stem (called rosella hemp) is used for various household purposes including making sackcloth, twine, and cord. A yellow dye was obtained from the petals of the flowers. The Roselle seed has 20% oil content.

Use as domestic animal's food for medicinal effect: Animal studies were identified in a few places. Roselle extract as acidifiers has been reported to boost trypsin activity, improve feed conversion ratio (FCR), and fat digestibility in post-weaning pigs (Aphirakchatsakun, W. et. al., 2008). The effect of Roselle calyx in layer diets on egg production, egg quality, and Thiobarbituric Acid Reactive Substances (TBARS) value in plasma and yolk was investigated to see if lipid peroxidation as a result of fat breakdown was occurring. The amount of time extract was stored was revealed to be a key factor in lowering egg quality and increasing TBARS levels in the yolk. (S. Sukkhavanit et al., 2011)

VALUE ADDED FOOD PRODUCTS FROM HIBISCUS

Hibiscus Tea: Hibiscus tea is a caffeine-free herbal tea brewed from the dried fruit section of the Roselle called the calyx, which comes from a specific variety of hibiscus called Hibiscus sabdarrifa. It's crimson and has a berry flavor (Dafallah & Al-Mustafa, 1996). It is well-known in Africa, America, Europe, and Southeast Asia. The use of Roselle tea to lower blood pressure and cholesterol and prevent cardiovascular disease is the most scientifically supported claim. Other less-studied health advantages of Roselle tea include aiding digestion, improving immunity, acting as an anti-inflammatory agent, and decreasing cancer risk. Roselle tea is also high in vitamin C, minerals, and antioxidants, and it can aid with hypertension and anxiety treatment. Roselle tea is created by steeping portions of the hibiscus plant, particularly the calyx, in boiling water. It has a red color and a sweet and tangy flavor that is similar to cranberries. Like most other teas, it can be consumed hot or cold depending on your preferences (Rao, P.U., 1996).

Candies: Candy is a sweet food made from fruits or vegetables that have been impregnated with sugar syrup, then drained of surplus syrup and dried to a shelf-stable form. Apples, ginger, mangoes, guava, carrots, and citrus peels have all been utilized in the making of sweets (Mehta and Bajaj 1984). The watery extract of hibiscus flowers is made

by boiling them in water and then using it to make hibiscus candy. After that, cooked or caramelized sugar, pectin, and citric acid should be added and heated once more. The gum acacia should then be molded and kept in the refrigerator.

Limitation for application in food: Although the popularity of beverage from hibiscus sabdariffa is increasing, one of its greatest limitations for large-scale production is that it has a very short shelf life of 24hrs if not refrigerates (40). Therefore, there is an urgent need to explore various preservation methods that could be employed to extend the shelf life of this product.

Future Approach: Among the properties reported to date, its effect on lipid metabolism, antihypertensive action, and apoptosis are largely studied. Some studies on its antimicrobial effects were also documented. The calyx of Roselle is rich in citric acid and pectin and so is useful for making jams, jellies, etc. It is also used to add a red color and flavor to herb drinks and could be roasted and used as a coffee substitute. It is found as an aromatic, astringent, cooling herb that is much used in Tropics. The leaves found antiscorbutic, emollient, diuretic, refrigerant, and sedative. The plant also reported being antiseptic, aphrodisiac, astringent, cholagogue, demulcent, digestive, purgative, and resolvent. It is used as a folk remedy in the treatment of abscesses, bilious conditions, cancer, cough, debility, dyspepsia, dysuria, fever, hangover, heart ailments, hypertension, neurosis, scurvy, and strangury. Therefore, with much enriching chemical-biological knowledge from animal and human models using plant extracts, future studies with greater scientific robustness in terms of standardization of dose for its effectiveness, safety and tolerability will permit the formulation of safe, effective therapeutic herbal formulations which can be used as an acceptable source for curing many food and health issues and restoring general health.

CONCLUSIONS

There have been numerous Roselle crop types produced, released, and used for commercial cultivation by farmers. All of the leaves and calyces of those types have both edible and therapeutic properties. The most popular calyces are the fleshy red ones. They are used fresh in the production of wine, juice, jam, jelly, syrup, gelatin, pudding, cakes, ice cream, and flavours, as well as dried and brewed into tea, spice, and butter, pies, sauces, tarts, and other desserts. The roasted seeds can be used in place of coffee. Although the young root is edible, it is extremely fibrous. Roselle is a tropical herb that is fragrant, astringent, and cooling. Antiscorbutic, emollient, diuretic, refrigerant, and sedative are all properties of the leaves. The fruits have antiscorbutic properties. Gossypetin, anthocyanin, and glycoside hibiscus are all found in the blooms. These substances may have diuretic and

choleretic properties, lowering blood viscosity, lowering blood pressure, and promoting intestinal peristalsis. The diuretic and antiscorbutic properties of ripe calyces are well-known. Antiseptic, aphrodisiac, astringent, cholagogue, demulcent, digestive, purgative, and resolvent properties have also been described for the plant. It has the potential to lower cancer risk. As a result, Roselle leaves, fleshy red calyces, and roots are vital to human nourishment and health care. Controlled research will be required in the future to demonstrate the efficacy of different portions of Roselle under varied settings.

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Active & Intelligent Packaging Technologies: An Aspect of Food Safety Management

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ABSTRACT

Consumer demand for food safety is expected to be a primary driver of public policies and industry-led efforts to improvefood-safetythroughеliminatingfoodquality information asymmetry. Food wastage in the food service industry accounts for roughly 30% of all food produced worldwide. Moreover, Every year, an estimated 600 million people become unwell as a result of consuming food contaminated with germs, viruses, poisons, or chemicals, with 4,20,000 people dying as a result. The majority of waste occurs as a result of inadequate packaging. For food manufacturers, modern packaging can be a long-term option for reducing food waste. Intelligent packaging is a useful tool in the battle against food waste since it may more accurately reflect the state of food commodities. We've covered the many types of active and intelligent packaging, as well as their techniques for protecting food during storage and the supply chain, in this post. According to our findings, smart packaging tries to protect the product from a variety of risks. Freshness indicators, in particular, can be an effective way to get safe food to consumers. Freshness indicators, in particular, can be an effective way to get safe food to consumers. The cost of employing modern packaging technology in developing nations is a source of worry. More research is also needed, and nanotechnology could be a beneficial tool for developing low-cost smart devices that can be integrated into smart or intelligent packaging to save money.

Key Words: Active packaging, Advanced packaging, Food safety, Food waste, Intelligent packaging, Sensor

INTRODUCTION

In the early times, humans used glass and wood containers for food packaging. Packaging as a term evolved from early mankind's basic need to store and transfer their food from place to place. Although there is no record of when the very first packaging materials were used, researchers believed that leaves, animal skins, nuts, etc. were being used to store and transport goods during the nomadic era.[1] Packaging keeps the product safe from the external environment and also performs four basic purposes such as protection, communication, convenience, and containment(fig-1).[2], Packaging ensures the item against the outside environment communicates with the customer via written texts or graphics, making the handling better and effective with different types of containers.[4] The expectations of consumers are continually changing. When new and revolutionary products emerge, so do the packaging techniques that accompany them. There have been several different ways to package goods in human history, each of which was advancement in its own time. The emphasis on the customer has remained consistent in the evolution of product packaging.[5] Smart packaging is still in its early stages of growth, but it has enormous potential.[6] The advancement of smart packaging has progressed very rapidly. Just a couple of years back, smart packaging used to mean a label on a package with a tracking number, or even better, a barcode readable by a laser scanner. The Quick Response (QR) Code has become extremely common in recent years.[7] This is an advancement in packaging that reflects the packaging industry's ability to adapt to customers' constantly changing expectations and concerns.[5,7] The popularity of Active Packaging, over the years, has signaled a significant change in packaging systems shifting from passive to active. Previously, primary packaging materials were thought to be "passive," meaning they only served as an inert shield to ensure the item against oxygen and dampness. Active packaging was first implemented several years ago as powerful packaging technology, capable of performing all packaging functions.[2] Smart packaging is one that includes both intelligent packaging as well as active packaging. Intel-

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ligent Packaging communicates with the consumer based on the information recorded.[8]

Literature Review

In recent times, consumers seek food that is both safe and convenient, as well as the food package should be made of recyclable or reused materials. Traditional packaging is becoming less capable of meeting all these demands, as a result of which consumers are switching to more functional packaging technology. Smart packaging is such a transformation of packaging technologies which is a combination of both active and intelligent packaging. As the consumer need is continuously changing so is the packaging technology to feed the world's growing population a safe and healthy food that will be more natural and less processed for its preservation and handling. Active packaging increases food protection as well as its shelf lifeby adding antimicrobial emitters or oxygen scavengers directly in food packaging film or as sachets in food packets. In the case of intelligent packaging, it functions by interacting with the food product and providing information like ripeness or indicating the freshness of the food.[9] These new emerging technologies can also help upgrade the traceability of any food product through its packaging.

Numerous studies are continuing forward in today's world, but they are yet waiting for it to be combined into innovative solutions. The packaging technologies should be so implemented that its customer can continuously monitor the food quality until they are consumed as well as food degradation should be reduced when preserved. [10] The world of smart packaging is significantly growing and advancing in research. This period is characterized by a significant increase in the number of projects and a probable approach to overcome food preservation problems with the new technologies and improved frameworks.[11]

Problem statement

The foodservice sector accounts for food wastage around 30% of all food produced worldwide.[12] This waste is produced from the food sector which includes below standard packaging or improper packaging that will not stand during transportation and distribution, specifically the perishable foods making it more vulnerable to lose. According to FAO, an absence of optimized packaging is one of the main factors responsible for food loss or waste, especially in developing countries.[13] New solutions to food packaging technology can be a promising way to fight against food wastage and to feed the increasing population.

Methodology for advanced Packaging Technologies to Reduce Food Waste

Active Packaging

Active Packaging is a concept that is characterized as a mode of packaging in which the package, the product, and the environment interact to extend shelf life, improve protection, and enhance sensory properties while preserving the quality of the product.[14] This includes the packaging of foods with materials that provide improved functionality, such as antimicrobial, antioxidant, or bio-catalytic functions. This can be accomplished by incorporating active compounds into the packaging materials or by the application surface alteration with the required functionality.[15, 16, 17] This packaging utilizes technology that is intended to discharge or assimilate compounds from the food or the headspace of food packaging, which extends the shelf life of products by slowing down the degrading reactions of lipid oxidation, microbial development, moisture loss and benefit more effectively than conventional food packaging(fig-2).[18]

There are different types of Active Packaging available, but generally, they are categorized into three types i.e. scavengers, emitters, and adoptors.

Scavengers

Package scavengers have been in use for around many years in the shape of separate packets or sachets but presently this technology is integrated inside the packaging material. This integrated approach decreases the overall costs and makes it easily approachable for both the manufacturer and the consumer.[18]

Oxygen scavengers

Oxygen scavengers or oxygen absorbers are included in packaging so it reduces the oxygen level within the package. They are utilized to keep up product qualityand to extend shelf life.[20] There are numerous types of oxygen absorbers available for a wide range of applications.[21, 22] The most commonly found substrate is iron followed by ascorbic acid and then other substances. These are incorporated into polymers as light-sensitive dyes.[18] The shelf-life and nutritional value decrease with the increase in oxygen amount in the food packet as the oxygen react with vulnerable foods in the package, accelerating the degradation of numerous food products, rancidity in foods with high oil content, and also promoting microbial growth.[23] The oxygen absorber scavenges this excess oxygen to slow down the oxidative reactions and also inhibits the microbial growth in the food package.[18] Beer-cap seal contains oxygen-absorbing liners on the underside of Carlsberg FreshCap - ZerO2. This removes the headspace oxygen and extends the shelf life of beer by 15%.[18, 24]

Ethylene scavenger

Ethylene scavenger can be a small sachet containing a suitable scavenging agent or an ethylene scavenger incorporated directly into the packaging material and the material should be greatly permeable to ethylene gases for its functioning.[25] This can be further sub-divided into

scavengers and absorbers, scavengers absorb water by chemical reaction whereas, absorbers absorb the ethylene from the surrounding atmosphere.[26] They increase the shelf life by slowing the aging or ripening process and senescence.[18] *Fruit Brite* by Hazel Technologies released 1-MCP (1-methylcyclopropene)[27] to diffuse ethylene blockers which extends the shelf life and the quality of the product [18, 27].

Moisture scavengers

Moisture scavengers regulate moisture in the headspace of any packaging and absorb the excess liquid weeping from a food product, thus increasing the shelf life of the product. High-capacity hydro-gels would be more effective in this case.[18]MoistCatch film by Kyodo Printing is a moisture scavenging film that is flexible and can be molded to any form.[18, 28]

Emitters

Emitters reduce the effect of microbial growth and activity, oxidative reactions, and even uncontrolled ripening in fruits. CO_2, antimicrobial, antioxidants, etc. acts as emitters that enhance the shelf life of products.[18, 29]

Antioxidant

Oxidation in fats and oils produces off-flavor as well as reduces the shelf life and causes spoilage in food. This can be avoided by incorporating antioxidants in food with higher fat content. They neutralize the action of harmful free radicals. Common antioxidants found in foods are Vitamin C, Vitamin E, citric acid, etc. [29, 30]

Antimicrobial Emitters

Antimicrobial emitters would include antimicrobial macromolecules having film-forming properties, sachet, using of bioactive agents in the packaging or on the surface of the packaging material. These are used to avoid microbial contamination in food products.[31] Some antimicrobial emitters are ethanol, organic acids, essential oils, and polysaccharides.[29, 32]

Basil, bay leaves, and cinnamon essential oils are effective against *Clostridium sporogenes* and *E. coli*, while cinnamaldehyde essential oil inhibits *L. monocytogenes*. Lipid oxidation is slowed by green tea extract. *E. coli, Staphylococcus aureus*, and *Pseudomonas spp.* are all inhibited by orange essential oil.[18]

CO_2 Emitters

Carbon dioxide emitters are most commonly used in combination with modified atmosphere packaging gases like nitrogen or with oxygen absorbers.[18, 29]

Intelligent Packaging

Intelligent packaging is a system that utilizes communication to encourage decision-making for extending shelf life and overall food quality and protection.[33] Intelligent packaging can carry out functions like sensing, detecting, tracing, warning about possible problems etc. Different Types of Intelligent Packaging are data carriers, Indicators and sensors.[34, 35]

Data carriers

Data carriers assist in the effective flow of information across the supply chain. The objective of data carriers is to ensure traceability, automation, fraud prevention, not to control product quality.[36] They store and transmit information about storage, delivery, and other parameters to ensure this. As a result, they're often seen on tertiary packaging. Barcode labels and RFID (Radio Frequency Identification) tags are the most commonly used data carriers.[37]

Barcodes and QR Codes

Barcodes are cheap, simple to use, and commonlyused to deal withsupplychain management, stock logging, and checkout.[36] In general, barcodescanbedividedintotwo types: one-dimensional and two-dimensional. They have differentstoragecapacitiesdepending on the type. A series of parallelspaces and bars make up a one-dimensionalbarcode. Data iscoded as a result of the various arrangements of bars and gaps. The coded information canbetranslatedusing a barcodescanner and an associateddevice.[32]

The combination of dots and spaces arranged in an array or matrix makes the two-dimensionalbarcodes occupy more memory power (such as packaging date, batch number, packaging weight, nutritional details, or preparation instructions). This is very convenient for both retailers and customers. An example of 2D barcodes is QR (quick response) Codes.[37]

Radio Frequency Identification (RFID)

RFID (Radio Frequency Identification) is a technology that uses radio waves to process data. RFID tags are advanced data carriers that can store up to 1 MB of data and capture real-time data without involving any touch or line-of-sight. These devices gather, store, and send real-time data to a user's information system RFID tags are more costly than barcodes and require a more efficient electronic information network.[37] On the other hand, the details on these tags can be loaded electronically and updated at any time.[38] RFID also has additional benefits for the entire food supply chain which include traceability, inventory control, and quality and safety promotion.[39] An RFID device is made up of three parts: a tag, which is made up of a microchip linked to a tiny antenna, a reader, which sends the radio signal and collect responses from the tag, and middleware, that connects the RFID hardware to enterprise applications(fig -3).[39, 40]

Indicators

The existence or absence of a substance, the magnitude of a reaction between various substances, or the concentration of a specific substance is all determined by indicators. Changes are direct, which means different color intensities are used to visualize this detail.[40] Depending on the indicator they are placed inside or outside of the package.[32]

Time Temperature Indicators (TTIs)

Time Temperature Indicators (TTIs) Temperature plays an important step in determining the shelf life of any food product. Deviations in the temperature profile can stimulate the development or survival of microorganisms, resulting in product spoilage. Besides, improper freezing may denature meat or other products' proteins. Time-temperature measures may be used to determine if the cold chain or optimal temperature is adequately maintained in the food supply chain or not.[37, 42]

TTIs are known as user-friendly and easily accessible devices due to their easy functionality.[43] The Fresh-Check from Lifeline technologies is an example of a TTI predictor. It works by causing a color shift in the indication range as a result of a polymerization reaction. A clear center indicates a fresh TTI. If the active center's color matches the outer ring, the product should be consumed as soon as possible. The dark core of TTIs indicates non-fresh products.[44] Some Commercially Available TTI are MonitorMark™,Timestrip®, Fresh-Check®, Checkpoint®.

The **3M MonitorMark® (3M Co., St Paul, Minnesota)**[48] is a diffusion-based indicator label that is based on the color change of an oxidizable chemical system regulated by temperature-dependent permeation through a filter. A blue-dyed fatty acid ester diffusing around a wick activates the action. At a temperature-dependent rate, a viscoelastic material migrates into a diffusely light-reflective porous matrix. The tag configuration, which differs by polymer concentration and glass transition temperature, controls the response rate and temperature dependence and can be set to the desired range.[46, 47] **Timestrips® (Timestrip UKLimited, UK)** are smart labels that keep track of how long a product has been open or in use. Food protection also necessitates temperature control at home. Timestrip® is a consumer-activated, single-use smart-label for tracking elapsed time on perishable items. It was created to allow customers to monitor the amount of time that had passed after activation.[49, 50]

Fresh-Check®TTI (Temptime Corp., Morris Plains, NJ, USA)(Fig: 4) is a solid-state polymerization reaction that produces a strong colored polymer. The TTI's answer is a color shift that can be measured as a decrease in reflectance.[47]

Freshness indicators

Freshness indicators track the consistency of food items as they are being stored and transported. Unfavorable conditions or a lack of durability may cause a loss of freshness. As a result, they send data on microbiological development, the presence of microbiological metabolites, and product chemical changes.[47,51] Glucose, organic acids, ethanol, volatile nitrogen compounds, biogenic amines, carbon dioxide, ATP degradation products, and sulphuric compounds are examples of quality indicating metabolites.[37,53] Freshness indicators must be mounted within the packaging to enable interaction with the compounds. Different methods may be used to detect this information depending on the reliable indicator (Table-1).[54]

Sensor

Sensors show the state of the food's quality concerning the indoor environment. Although the actual indicator shows the quality status, a sensor senses and responds to changes in the environment within the packaging.[58]

Gas sensor

The gas sensor detects carbon dioxide in the package as a sign of microbial growth, which shortensthe food's shelf life.[53] Non-dispersive infrared (NDIR) or chemical sensors are the most common types of CO2 sensors. NDIR sensors are spectroscopic sensors that use gas absorption at a specific wavelength to test CO2 content.[57] Although this sensor reacts to the formation of a spoilage metabolite, it does not explicitly track a quality attribute. CO2 is a useful indicator of food quality and can be used as an indicator compound; however, it is not a quality attribute because CO2 does not cause bad taste or spoilage; quality loss is caused by microorganisms. It is a colorimetric indicator label that monitors the freshness of a dessert (fig- 5).[58]

Biosensor

Biosensors detect pathogenic bacteria on food that cause food safety issues. These are specifically monitoring the quality attribute of food. The Food Sentinel System™ (SIRA Technologies, California, USA) is an example of such a biosensor, which consists of a barcode that contains a membrane with antibodies that can bind to particular pathogens.[47] The barcode changes color as the pathogenic bacteria develop during storage, resulting in a barcode that can no longer be scanned.[58]

DISCUSSION

Smart packaging strives to protect products from a variety of risks while also allowing for more active and intelligent packaging applications to be commercially viable. It's critical to keep the ultimate cost of intelligent packaging systems to a small percentage of the overall package cost, as well as to overcome the inherent challenges of transitioning laboratory trials to industrial-scale manufacturing. Multiple functionalities can be combined into a single packaging, and

single-use throwaway products can be replaced with long-lasting reusable devices.

CONCLUSIONS

Though the idea of intelligent packaging has not grown rapidly it is the technology of the future. Smart packaging aims to provide safety to the product from all kinds of hazards. To ensure that more active and intelligent packaging applications become commercially feasible and "into everyday packaging commodities" around the world, it is important to ensure that the final cost of intelligent packaging systems is a small fraction of the overall packaging cost and resolve the inherent difficulties in converting laboratorytrials to industrial-scale production. Incorporating multiple functions to be integrated into a single package and replacing single-use disposable products with long-lasting reusable devices. Significant technical advances are still needed to realize these growth goals. Only then it will provide a safe ground for monitoring the food item and controlling the distribution correctly.

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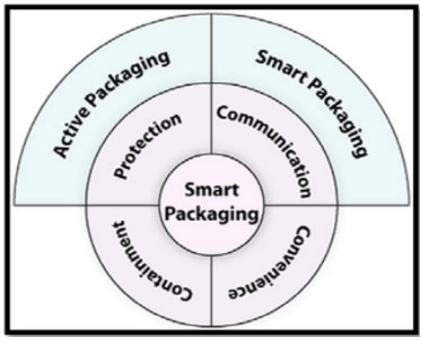

Figure 1: Different types of packaging[3].

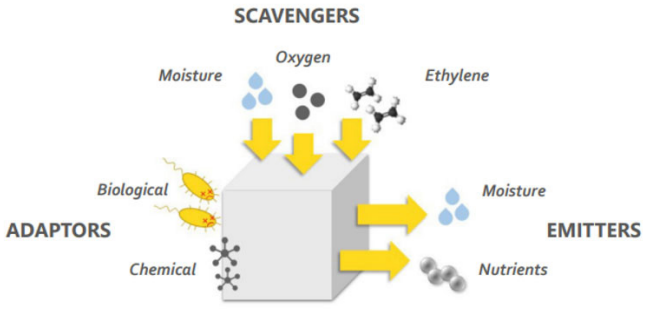

Figure 2: Working model of active packaging[19].

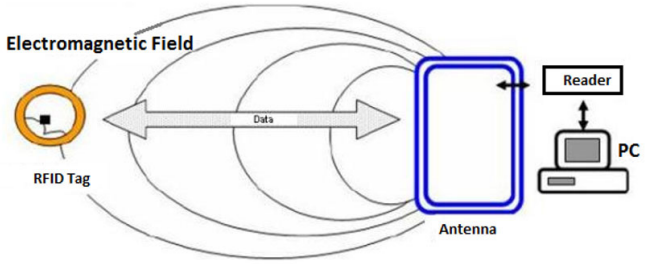

Figure 3: The workingprinciple of radio frequency identification (RFID) tag[59].

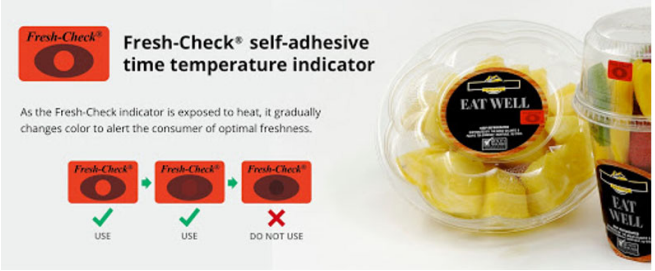

Figure 4: Principle of Lifeline'sFresh-Check Indicator (TTI)[44].

Figure 5: A sensorthat monitors carbondioxide as an indication for the freshness of the dessert golden drop[53].

Table 1: Principles of indicators and sensorsbased on metabolites[53- 55]

Metabolites	Food Products	Indicators	Sensor
Glucose/lacticacid	Fermentedfood, meat	Colorimeterbased on pH	Electrochemicalsensor by redox reaction
Carbondioxide	Fermentedfood, meat, seafood	Colorimeterbased on pH	Electrochemicalsensor by silicon-basedpolymers
Oxygen	Meat, vegetable, fruits	Optical sensor by fluorescence, colorimeterbased on pH	Electrochemicalsensor, laser
Biogenic amines	Fish, meat	Color-changing pH-sensitive dyes	Electrochemicalsensor by enzyme redox reaction

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Review Article

Microbial Spoilage of Meat and It's Detection - A Review

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Abstract

Spoilage of meat is a metabolic process which occurs if the meat is left untreated under unsuitable conditions like low oxygen, high water activity & low temperature, hence it becomes unacceptable for human consumption. Meat spoilage is generally caused by unavoidable infections & decomposition of meat by bacteria & fungi. The microorganisms usually come in contact with the meat through the person handling the meat or borne in the animal itself. Unattractive odours & flavours, discolouration, gas & slime are produced by the microbes associated with deterioration of meat. For so long, food industry has been looking for technologies to detect deterioration of meat. Few detection methods are being used in food industry these days to ensure freshness of meat & customer satisfaction such as spectroscopy, use of AI methods, biosensors etc. In the present review article, it has been focused on the detection of meat spoilage by FT-IR spectroscopy with PLS Analysis method, Xanthine Oxidase enzyme biosensor method & Enumeration method.

Keywords: Spoilage of meat; Water activity; Spectroscopy; AI methods; Biosensors; Xanthine; Oxidase enzyme; Enumeration Method.

Introduction

The demand for poultry and poultry products is increasing day by day in both international and domestic markets [1] in order to protect and maintain human-health. Safety and quality are considered as the most important concerns in the food industry as they are directly related to get healthy life. Our human body requires proper and maintained diet comprising of all required nutrition to carry on the daily life-functions [2].

This required diet contains macro - nutrients and micro nutrients which can be found from a number of food source including cereals, meat, legumes, fruits, milk and vegetables [3]. Being nutritious, meat provides energy to the human body to perform daily activities by fulfilling the requirements needed by the body [4]. Meat is considered as a rich source of amino acids, essential fatty acids and vitamins [5] .

Meat is a good source of nutrition and different kinds of meat (e.g., chicken mutton, lamb, beef, fish etc.) has different composition with different nutritional values [6]. Due to increase in concerns of consumer over food quality and food safety, it becomes a very important need for Industries to ensure safe, unspoiled and healthy food to the consumer as food is related to increase in morbidity, mortality, human suffering and also affects economy [7]. To comply with the need a momentous effort made by meat industry has been observed to ensure the quality and safety of meat products which includes food spoilage, food poisoning and food waste [8].

Meat gets spoiled for various reasons but microbiological spoilage in meat occurs with the growth of microorganisms. The spoilage of meat is identified by its organoleptic changes which make the meat unacceptable to eat [9]. These changes include appearance (discoloration), changes in odours, changes in taste, slime formation. This may result from formation of metabolites, decompositions, conversion of organic and inorganic matter and by enzymatic activities which occur within tissues after post-mortem can lead to change during storage time due to the growth of microorganisms [9]. Basically, food gets rejected when it gets spoiled by triggering some characteristics which makes the meat unacceptable to the consumer [10].

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Detection Methods of Non-permitted Food Color, Metanil Yellow: A Review

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ABSTRACT

Food adulteration is a primary global concern for public health, especially in developing countries, due to the lack of monitoring and appropriate policy developments and executions. Due to its high demand in international trade, turmeric (Curcumina Longa) is subjected to economically motivated chemically unsafe adulteration, namely metanil yellow. Metanil yellow (3-4)-anilinophenylazo) benzene sulfonic acid sodium salt), is a hazardous dye and a common adulterant used in turmeric powder and other yellow colored food products. The toxic chemical travels in blood and reaches various organs and interferes with various cellular metabolic processes there. Our earlier studies reveal that metanil yellow generates oxidative stress in various vital organs such as heart, liver, and kidneys. As per the guidelines of food quality some conventional methods are used but these techniques possess various limitations. This study aims to review the use of FT-Raman and FT-IR spectroscopy for evaluation of metanil yellow in turmeric powder.

KEYWORDS: *Non-permitted food colors, metanil yellow, turmeric powder*

INTRODUCTION

There are several types of dyes used as food additives and food colorants. Metanil yellow is a yellow dye used extensively as a food colorant. It is made from diazotized metanilic acid and diphenylamine [1]. Azo dyes are also used in laboratories as biological indicators. Turmeric (Curuma long L.) is an appetizing root commonly used for food seasoning and for medicinal purposes. Turmeric has a long history of medicinal use in Asian countries (Reema F Tayyem et al. Nutr Cancer. 2006[2]) and is used in root, oil, and powder forms. Its medicinal value is mainly due to its content of curcumin (diferuloyol methane) (T Osawa et al. Biosci Biotechnol Biochem. 1995 Sep [3]) with attributed medical properties including anti-inflammatory, anticarcinogenic, antioxidant,and wound-healing effects(B Joe et al. Crit Rev Food Sci Nutr. 2004[4]). Curcumin has also been reported to have promise for development of therapies for Alzheimer's disease (Tsuyoshi Hamaguchi et al. CNS Neurosci Ther. 2010 Oct [5]).

According to the sources it has shown that the nutrient and acidity content in soil, fertilizer, soil type and cultivar affects the curcumin content in turmeric. Reported curcumin concentrations in turmeric range from 0.3% to 8.6% [3,6-9]. Curcumin is isolated from turmeric for medicinal and cosmetic purposes. Although whole, dried, or fresh turmeric are mostly free of contamination, turmeric powder can be deteriorated with different chemical powders used as substitutes for curcumin (Sasikumar.B et al. 2004 [10]). It has been using in many unorganized

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ORIGINAL ARTICLE

Synthesis of activated carbon material using sawdust as precursor and its application for dye removal: batch study and optimization using response surface methodology

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Abstract

In the present study, an inexpensive adsorbent has been synthesized from waste sawdust which can remove the highly toxic dye indigo carmine (IC) from aqueous solution. Activated carbon from sawdust was synthesized using physical and chemical treatment. After using the adsorbent in batch-dye adsorption experiments, it has been characterized by SEM, FT-IR and XRD which showed significant up-taking capacity (77%) of the dye on its surface. Sensitivity of the dye removal process has been analysed by undergoing batch study with varying initial concentrations of the IC dye, adsorbent dose, pH and temperature and optimization of the process which indicated the optimum condition of the experimental parameters. Various isotherm models and kinetic models have been used for fitting of experimental data and examined to analyse efficiency of the adsorption mechanism. Langmuir isotherm and pseudo-second-order kinetics were found to be followed by adsorption process over the entire dataset of tested experimental results. The maximum uptake capacity was found to be 30 mg g^{-1}. Thermodynamic investigation was also conducted to project the spontaneity of the reaction.

Keywords Sawdust · Waste biomass · Biochar · Low-cost adsorbent · Dye removal · Indigo carmine (IC) · Adsorption · Environmental pollution

1 Introduction

Various industries (paper, leather, food, cosmetic, textile, etc.) use dye for colouration of their product [1, 2] and thus ending up discharging a considerable amount of dye in water body in the form of waste water. Discharge of waste water containing dye discharges into the environment causes detrimental effect on flora, fauna and human beings [3, 4]. There are various methods (physical, chemical, biological) that are being employed to remove excess dye from the waste water before discharging into the environment [5, 6]. Among all other techniques, the superior one is found to be the adsorption technique with respect to low cost, ease of operation and simplicity of design [7, 8]. The most widely used adsorbent is activated carbon because of high pore size and surface area [5].

Indigo carmine (IC) is a synthetic blue colourant (acid dye) and comprises of two sulfonated groups (negatively charged) coupled with four benzene rings. It is a typical recalcitrant dye with high solubility (10 g/l) [9] and used as colouring agent in various industries. Discharge of IC dye beyond permissible limit can cause potential risk to human health and cause development of acute neurotoxicity [10], hypertension and cardiovascular disease [11, 12], diarrhoea, nausea etc. [13, 14]. It is a highly toxic dye and even touching may cause human eye and skin irritation and may cause permanent damage to cornea [15, 16].

As taking in consideration of the toxicity of the dye, diverse conventional techniques are used like photocatalytic degradation, electrodialysis, coagulation, ozonation and adsorption for the removal of IC dye from polluted water [17–21]. Though these processes are tedious and non-economical, however, the adsorption technique among all these techniques is found to have shown high removal efficiency and better operational characteristics [22].

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A Review on Cocoa Butter Alternatives in Chocolate Preparation

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ABSTRACT

Cocoa butter naturally occurs in cocoa bean. It is present about 50% of cocoa nib. It is highly resistant to oxidation due to presence of high level of natural tocopherol. It is brittle at room temperature and its melting point is between 34° C to 38° C. But, cocoa butter is expensive and its price is subjected to large fluctuations. That's why some alternatives for cocoa butters are produced, such as cocoa – butter equivalents (CBEs , like from enzymatic inter-esterification of tea seed oil and fatty acid methyl esters), cocoa-butter substitute (CBSs, esterifies propoxylatedglycerin containing acyl groups derived from saturated linear fatty acids, at least 50 moles percent of the total acyl groups are used) and cocoa-butter replacers (CBRs, like evaluation of milk fat fractional and modified techniques for making CBR.) Their composition according to triglycerides, fatty acids, sterols and other unsaponifiable components are discussed in this paper. Coconut oil, non-lauric contained fats like palm oil, soybean oil, rapeseed oil, can be used as replacer. These alternatives have various advantages; it improves fat stability, reduces fat migration, and incorporates softness to the product. As the alternatives do not require tempering, it is easier to achieve glassy texture. This work reviews on the theory of the compositional data of vegetable oils, and fats which are used as cocoa – butter alternatives in the production of chocolate.

KEYWORDS: *cocoa butter alternatives, melting point, chocolate*

I. INTRODUCTION

Cocoa bean (CB) is the fatty seed found inside a cocoa pod, fruit of the

Theobroma cocoa plant. It is a small evergreen tree that belongs to the family Malvaceae. There are several processes which undergo the preparation of cocoa butter. It is brittle in Temperature below 25°C soften in hand and melts in mouth having a temperature of about 34°C [33]. Cocoa butter has several advantages which makes it the main ingredient saturated fat and less amount of caffeine and theobromine. It also contain some vitamins in the soluble form such as vitamin E in the form of beta – tocopherol , alpha – tocopherol and gamma – tocopherol. Among all this form of tocopherol,only beta – tocopherol is used for

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Organizing The Unorganized: An Overview of COVID-19 Impact On FMCG Sector and Indian Economy

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Abstract

Fast-moving consumer goods or FMCG sectors have a significant role in the Indian economy. This part is now confronting some issues because of the significant lockdown in the light of the new corona virus which resulted in the occurrence of the pandemic. There are two market divisions of FMCG sectors, they're organized and unorganized, uniquely the chaotic part is unorganized sectors are greatly influenced by the lockdown in pandemonium. The FMCG sectors have indicated an amazing development for recent years. The aim of the review to focus the impact of a worldwide pandemic on the FMCG segment in India and the behavioral changes of customer and how the FMCG sector will boost the economy. The government polices and different technology stack like automation that can be included in the FMCG sector can bounce back and boost the economy. Furthermore, more investment particularly on livestock sector can contribute 1% to the annual GDP. Alongside, a continuous effort should make in public private partnership model to create bridge between the organized and unorganized sector.

Keywords: FMCG, Covid-19, Food Sector, Technology stack, organized sector, unorganized sector, public private partnership

1. Introduction

India is the 5th largest economic force in the world with 3.202 trillion US$ (Nominal; 2020). FMCG is the 4th biggest economy supplier in India with a market size of 52.75 billion US$. Fast-moving consumer goods are non-durable products that sell quickly at relatively low cost. FMCGs have low-profit margins Fast-moving consumer goods are an inexpensive product. These items are perishable and require small shopping endeavors. FMCG sectors have a wide assortment of the range including biscuit packets to toiletries. This division has provided very nearly 3 million work openings, which is nearly 5% of the total factory employment (Dabur annual report; 2017), but has seen a huge decline in the current scenario but interestingly the food market has seen a surge of almost 40%. Most of the essential food items are out of stock in the market because the majority of the food sectors are unorganized market player. There are two different divisions in FMCG sectors, they're organized and unorganized. But these unorganized parts are facing major problems due to the pandemic situation which results in the lockdown of markets. The majority of the absolute workforce of the nation is from the unorganized sectors. The organized sectors have confronted this equivalent circumstance yet but they're bouncing back rapidly. We'll discuss in this paper the behavioral changes of consumers in respect of FMCG sectors in this pandemic situation and some advisory solutions to overcome this uncertainty of unorganized sectors and to bring the unorganized market played into an organized market player. While the unorganized market player which runs our informal income are the ones which are in higher risk in this pandemic and it's expected that more than 400 million people which help running our informal economy may lose their job.

2. IMPACT OF COVID 19 ON FOOD SECTOR (FMCG) AND LIVELIHOOD IN INDIA

With the intent to stop the spread of viruses the lockdown has been imposed and the situation remains volatile with the trajectory of the corona virus undetermined and a significant fall in the economic fallout according to HUL chairman - Sanjeev Mehta [1]. The government views the pattern of the spread of COVID-19 as similar to the 2009 H1N1 influenza pandemic, meaning the spread is unlikely to be uniform. After the unlock III, it is quite expected to maintain the full lockdown in "hotspot" areas and relax it in other places and started to unlock the country once again with full flow but with safety measures. While in some places across the Country and various states, the state government decided to impose strict lockdown again due to the current scenario of COVID-19. The FMCG sector has seen a huge decline in the current scenario but interestingly the food market has seen surge online sales were a mere 2.8% of the overall sales for FMCG companies in the first quarter of 2020. Kerala-based packaged foods company Elite Foods saw a 100% jump in online sales in certain regions for its products that include cakes, bread and buns, Indian instant mixes,

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A Review on Utilization of Biosensors for Detection of Adulteration in Fish

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ABSTRACT

The consumption of fish has lately seen an upward trend in recent days considering the wide range of health benefits of fish and sea foods and with it, the issues of prevalent adulteration of fresh fish with unapproved chemicals and additives have came into light both through electronic and print media. Several instances of adulteration of fish and fishery products with unsafe chemicals like formaldehyde, ammonia and additives like sodium benzoate has been highlighted in a number of reports and research papers. Presence of these adulterants in freshly marketed fish seriously compromises health of consumers and daily ingestion of considerable amounts of these adulterants can generally cause severe abdominal pain, coma, renal injury, vomiting and possible death. This has aroused concerns regarding the safety and quality of fish as well as the necessity of a reliable and faster technology which can easily identify the contaminants and toxicants in food materials. As per regulatory guidelines of food quality some conventional methods are used but these conventional techniques possess various limitations. Biosensor is an analytical device which can replace these conventional techniques and offers a quick on-site monitoring with accuracy and provides an index of quality of the product in real time. This study aims to review the recent advancement in biosensors and their contributions in determination of adulteration and freshness concerning fish and seafood safety.

KEYWORDS: *Adulteration of fish, Formaldehyde, Ammonia, sodium benzoate, Biosensor.*

INTRODUCTION

Fish is a healthy food and serves as a most important source of animal proteins and great source of ω-3 PUFAs and micronutrients for people worldwide **(Mohanty et al. [1])** mainly in the underdeveloped and developing countries. High consumer demand for fish and fish products has resulted in enhanced fish trade in various countries. To cater the need of consumers, fish is exported from the place of production to various distances. As fish is perishable, the flesh of fish can spoil quickly and it should be eaten on the day of capture, unless cured **(Marzuki et al. [2])**. In order to extend the storage life as well as to improve the sensory attributes i.e. appearance, fishermen and fish vendors tend to carelessly use hazardous chemicals like formaldehyde and ammonia and additives such as sodium benzoate in various fish and sea foods. Formaldehyde has been identified "as carcinogenic to human" by IARC (International Agency for Research on Cancer) **(Bianchi [3])** .As consumption of these adulterants is hazardous to human body, it is important to investigate the presence of adulterants as well as the quality of fish. Various methods have been adopted for detection of adulterants like liquid

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STUDY ON THE FORTIFICATION TECHNIQUES OF MULTIPLE FOOD PRODUCTS USING IMMUNITY BOOSTING MICRONUTRIENTS AND ANTIOXIDANTS: A LITERATURE REVIEW

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***Abstract*: During this ongoing period of the devastating pandemic of COVID-19 caused by Novel Coronavirus, the term "Immunity" has become quite a catchword, and a strong and healthy immune system has become the need of the hour to build up our body resistance against pathogens and provide protection against them. Researches on various nutritional components and their bioavailability point to the fact that there are several micronutrients and trace elements whose intake through diet can help in triggering up the functioning of the immune system. Nowadays, as per the Food Safety and Standards (Fortification of Foods) Regulations, it is also advised that we must buy and consume products that have the "+F" logo or fortification logo which means that those products are enriched in certain added vitamins and trace metals from which the benefits of a stronger immune response can be obtained. It has been observed that among the vitamins, vitamin A, C, D and E and the mineral zinc play a significant role in boosting up the immune response through their interactions with the cells of the immune system. Also, antioxidants like β-carotene, anthocyanins, etc play a major role in the immune system functioning by lowering down the level of oxidative stresses in the body. These immunity boosting vitamins, minerals and antioxidants can be incorporated into regular food products through the method of fortification of the products or even, they can be added into an immunity boosting drink, powder or supplements. Various researches and reviews demonstrate how these micronutrients can be added or incorporated into a food product; they can be obtained from artificial/synthetic sources or natural sources like fruits containing these vitamins and minerals can be used as functional ingredients in the products. Sometimes, multivitamins or minerals can be incorporated into the same product. Therefore, the following review will be based on the study of the methods in which various products have been fortified from time to time with immunity boosting nutrients like vitamins A, C, D and E, zinc and antioxidants as demonstrated in numerous research work. It will be a detailed study on the techniques followed during the fortification procedures as well as the sources from which those micronutrients and antioxidants are obtained. The roles played by the micronutrients in building immunity will also be discussed.**

***Index Terms* - Immunity, Fortification, Bioavailability, Vitamins, Micronutrients, Antioxidants, Minerals, Regular food products**

I. INTRODUCTION

Immunity is the body's internal capability to resist the harmful effects of an invading pathogenic microorganism or even minimize the effects of infections caused by them. It is mostly an internal factor of the body and the strength of a person's immunity depends mainly on the strength of the immune response generated by his immune cells. However, there are certain micronutrients which are observed to enhance this overall functioning of the immune system and these elements are mostly obtained from consuming foods which are rich in them. The vitamins A, C, D, E and the mineral zinc are the micronutrients which are observed to perform such immunity boosting activities. Each of these micronutrients hasits own distinct mechanism through which it triggers the

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Onion Productivity and Price Change Aspects in India: An Overview

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ABSTRACT

AlliumCepathe scientific name of an onion. After potato Onion is the second most essential vegetable in our India. And also onions are very famous in all around the world. In India, the productivity of onion is about 13 lakh tons every month, and in the world, the onion productivity ratio is about 19.40 million. There are about 100 types of onion throughout the world and basically, India produces 9 types of major onion. Onion is very rich in vitamin C (12%)content and vitamin B-6(5%)content and also rich in minerals like iron(1%) and calcium(2%). In the last 10 years, Maharashtra(4905.0 thousand tons) is the biggest onion producing state in India. But in 2019 onion prices overlap at Rs 10 kg from Rs 100 kg as demand loss will take place. A huge amount of wastage of onion takes place every year due to bad Monsoon, transport system and the amount of wastage is nearly 25% of the total production. In 10 years a remarkable increase in the production of onion in India and also an increase in the area about 768,000 ha to 1064,000 ha. Onion production has been several benefits like it reduces our cholesterol level, fights against inflammation, decreases triglycerides and it contains a high amount of antioxidants. The impact of onion production on the Indian economy, an increase of onion productivity, price drop, Government policies related to onion production also have been focused on in this review.

KEYWORDS: *Onion production, government export policies, Wholesale price, Price change, Storage of onion*

I. INTRODUCTION

Onion is the second largest production crop in India and also all over the world [1]. The best season for onion production in India is August October, and for hilly areas, the best time for onion production is September to December[2].

Throughout the world, China is the most onion producing country and produces 20507.76MT onions whereas India produced 15118.00MT onions per year. Maharashtra is the best onion producing state in India, produced 8474.73 thousand tons of onion per year. But As per the current report onion is expected to be 20% less in the country and also a reduction of 42% expected in Maharashtra due to bad climate conditions [3].

The average wholesale cost of onion in India is 1280.32 Rs/quintal. And a total of 15.89 lakh MT Onion is exported in 2018 and in 2019 the export structure is 15.22 lakh MT [4,7,9]

Besides production argumentation, there are several policy tools available to arrest the increasing prices such as the withdrawal Of Merchandise Export Incentive scheme (MEIS) the rewards under MEIS mostly in form of transferable duty credit scripts and to encourage exports and curb free fall in prices for Onion at home, the MEIS

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Sustainable Environment Research

RESEARCH Open Access

Activated carbonaceous materials from tea waste and its removal capacity of indigo carmine present in solution: synthesis, batch and optimization study

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Abstract

The present work determines efficiency of domestic food waste like tea waste in removing indigo carmine from synthetic textile wastewater. Carbonaceous material (tea waste) has been employed and it showed removal percentage of indigo carmine at 90% through adsorption process. Carbonaceous material was chemically activated by using modified Hummer's method and it was observed through Scanning Electron Microscopic image, Fourier Transform Infrared Spectrometer, X-ray diffractometer and Brunauer, Emmett and Teller analysis that revealed that the modified biochar is comparably similar to graphene oxide (GO). Various experimental parameters are evaluated for the removal efficiency of the synthesized adsorbent under the present study. Results of the experiments performed using the GO-like adsorbent synthesized from tea waste confirmed potential efficiency of adsorption of indigo carmine dye from synthetic waste water solution. The adsorption mechanism has been analysed by fitting the experimental data in different adsorption isotherm and kinetic models. The results indicated that the adsorption followed Langmuir isotherm model with maximum uptake of 20 mg g^{-1} and pseudo second order kinetic model with the best correlation coefficient. The thermodynamic study showed the dye removal to be spontaneous and endothermic.

Keywords: Indigo carmine (IC), Adsorption, Tea waste, Environmental pollution

Introduction

Dyes are a specific group of chemical pollutants, posing serious environmental problems, due to annual production in large amounts from different industrial sector like textile industry [1–3]. If this wastewater is released into a natural aquatic system, the photochemical activities of that aquatic system are adversely affected by the coloration of dye which reduces light penetration. Carcinogenic dyes might cause mutations in organisms [4, 5]. Dyes are chemically designed and manufactured to be resistant to degradation by oxidizing agents, light, high temperatures and hence, cannot be easily removed by the conventional wastewater treatments methods [6, 7].

Indigo carmine (IC) dye is widely present in wastewater produced from textile, food, cosmetic, pharmaceutical and paper industries [8–12]. According to WHO, the permissible limit of indigo carmine dye is 5 μg L^{-1} in water [13]. Wastewater containing IC dye must undergo treatment before discharging into the environment as it may cause skin and eye irritation, cancer to human [14–16]. Various methods that are based on aerobic or anaerobic biodegradation and photodegradation are not 100% efficient for removal of most of the dyes from wastewater. The various

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Overview of Worldwide Potato Production Scenario with Special Focus in India and Its Industrial Utilization

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ABSTRACT

India became the planet´s second-largest potato producing country all over the world because potato output increased from 1.3 million to over 34 million over the last six decades. Despite that, this spectacular increase makes a series of less readily apparent tendencies in the growth rates for potato production, area, and yields. When the area harvested enlarged, the growth for area harvested touched a series of peaks and valleys; as yields per hectare continuously increased, the growth rate for productivity gradually decreased to a half. In the present year, Uttar Pradesh is the major Potato producing State with 31.26% of production share, followed by West Bengal, Bihar, Gujarat, and Madhya Pradesh with 23.29 %, 13.22%, 7.43%, and 6.20% share respectively. This paper analysis is based on the driving factors behind the increase in production, area harvested, and yields. Sub-sector specific recommendations include greater eco-efficiency in cold storage.

KEYWORDS: *Potato production, potato Nutrition, Potato varieties, Industrial utilization*

I. INTRODUCTION

Potato is a root vegetable along with that it is also a cool-season vegetable which is in part with wheat and rice because it is one of the most important staple crops in the human diet all around the world. Potato is a specialized underground storage stem which is also known as "tuber". According to FAO (the Food and Agriculture Organization) potato is devoured by more than one billion people around the world. It is a high-quality vegetable as well as food crop used in the reparation of more than 100 types of recipes in INDIA. The protein of potato has high biological value than protein in cereals and milk [1].

Potatoes are rich in vitamins, minerals, and antioxidants, which make them very healthy. Studies say that potatoes have a variety of impressive health benefits, including improved blood sugar control, reduced heart disease, etc. One medium baked potato (173 grams) including the skin, provides Calories: 161 grams Fat: 0.2 grams, Protein: 4.3 grams Carbs: 36.6 grams Fibre: 3.8 grams Vitamin C: 28% of the RDI Vitamin B6: 27% of the RDI Potassium: 26% of the RDI Manganese: 19% of the RDI Magnesium: 12% of the RDI Phosphorus: 12% of the RDI Niacin: 12% of the RDI Folate: 12% of the RDI The nutritional content of potatoes can vary by the variety of it and how they are prepared. For example, frying potatoes adds more calories and fat than baked

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A Review on Anthocyanin Pigments with respect to its Nutraceutical Properties

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ABSTRACT

Anthocyanin pigments are readily degraded during processing and storage of foodstuffs that can have a dramatic impact on color quality and may also affect the nutritional properties. Total anthocyanin pigment content and indices for polymeric color and browning are easily measured with simple spectrophotometric methods. Once individual pigments are identified, their changes can be monitored by high-performance liquid chromatography (HPLC). The edible fruits of 12 plants were extracted in methanol and subjected to solvent–solvent partitioning to yield three fractions, hexane, ethyl acetate, and aqueous. A number of factors affecting anthocyanin stability and color are discussed in this review. Anthocyanins are probably the most spectacular of plant pigments since they are responsible for most of the red, purple and blue pigmentation of flowers, hits and vegetables. However, because of their highly reactive nature, anthocyanins readily degrade, or react with other constituents in the media, to form colorless or brown colored compounds. The presence of an oxonium ion adjacent to carbon 2 makes the anthocyanins particularly susceptible to nucleophilic attack by such compounds as sulfur dioxide, ascorbic acid, hydrogen peroxide and even water. Loss of anthocyanin pigmentation also occurs in the presence of oxygen and various enzymes, and as a result of high temperature processing. Certain degree of pigment stabilization may be conferred by acylation with various organic acids, co pigmentation, self-association and/or metal chelation. In addition, pH has a marked effect on anthocyanin stability, and on the color of media containing these pigments. A number of anthocyanin-rich sources have been investigated for their potential as commercial pigment extracts. Although their application is primarily limited to acidic media, continued research on the chemistry of anthocyanins may lead to application and stabilization of these pigments in a wider variety of food products.

KEYWORDS: *Anthocyanins, Natural pigment, Pigmentation, acylation, chelation, stabilization, fortification.*

I. INTRODUCTION

Anthocyanins are water-soluble vacuolar pigments which depend on their pH, which may appear red, purple, blue or black. There are many food plants which are rich in anthocyanins include the blueberry, raspberry, black rice, and black soybean and many others pigments colored red, blue, purple or black.[12]Anthocyanins comprise a group of naturally occurring pigments which are responsible for the blue, red, purple, violet and magenta coloration of most species in the plant kingdom. These polyphenolic substances are glycosides of anthocyanins, polyhydroxy and polymethoxy derivatives of 2-phenylbenzopyrylium or flavylium salts. The large number of glycosyl and acyl groups which may bind to the sixteen different naturally occurring anthocyanidins has

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HIBISCUS PETAL EXTRACTION FORTIFIED FRUIT JUICE- A HEALTH DRINK.

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Abstract:-
The aim of this paper was to bring out the beneficial properties present in petals of hibiscus flowers and their fortification in fruit juice. One of the flowers of Indian Subcontinent is "Hibiscus rosa sinensis" which is rich in antioxidants, anthocyanins, flavonoids. Main coloring pigment is anthocyanin which is proved to cure cancer, lower down cholesterol level and clear the digestive tract. Freshly plucked hibiscus flowers were taken and their petals were removed by hand. Petals were put in a tray drier for drying at 51.8°C. After drying they were crushed into fine pieces manually.100 grams of powdered leaves were obtained. Anthocyanin being water soluble, the powder was boiled in water at 80°C.The anthocyanin pigment was extracted in liquid form. It was mixed with lime juice and polyphenol content was measured by gallic acid equivalent method. Final product obtained showed 13 times increase in polyphenol content compared to commercially available fruit juice. Hence the above juice can be used as an effective health drink for human consumption and protect the body from free radical damage.

Keywords: **- Anthocyanins, polyphenols, gallic acid equivalent method**.

INTRODUCTION

Flowers and other parts of the plant are used to make medicine. Hibiscus is used for conditions such as high blood pressure, high cholesterol, increasing the production of breast milk etc. It is a flower which is widely grown in the Indian subcontinent and is available around the year. Many varieties are available worldwide among which the variety which is widely available in India is "Hibiscus rosa sinensis". The herb "Hibiscus rosa sinensis" (Malvaceae) is native to China. Many species of Hibiscus are grown for their showy flowers. It is a shrub widely cultivated in the tropics as an ornamental plant and has several forms with varying colors of flowers. Hibiscus has also medicinal properties and takes part as a primary ingredient in many herbal teas. The red flowered variety is preferred in medicine as reported by Vincenta Khristi and V. H. Patel (2nd November, 2016). According to Pragya Singh et al (31st May, 2017), the flower plays a crucial role in treating medical problems including many cardiovascular disorders, helmenthic disease and cancer. The plant also act as an anti oxidant and used in obesity management. The vitamin C naturally found within the hibiscus works to complement the iron, increasing its absorption in blood and acts effective cure for anemic patients. Anthocyanin-rich mixtures of bioflavonoids may provide protection from DNA cleavage, estrogenic activity, enzyme inhibition, boosting production of cytokines ,anti-inflammatory activity, decreasing capillary permeability and fragility, and membrane strengthening Mary Ann Lila (12th May, 2004). Being water soluble the pigment can be easily extracted by using water and thus by fortifying it with regular food items can serve as beneficial and cheap source of nutritional super foods. Studies of Yasuyuki Nakamura et al (8th September, 2014) showed that red colored pigments which are present in the flower are mainly anthocyanins which have been widely used as coloring agents. Major content present is cyanidin-3- sambubioside and delphidin-3-sambubioside from which the conclusion comes that the major component in the petals of hibiscus flower is cyaniding-3-sambubioside, although it contain many other strains of anthocyanins including many hybrid forms so it is still a question that whether every hibiscus flower produces cyaniding-3-sambubioside as the major anthocyanin flora or not. Research of Jadhav et al (2nd July, 2009) all the parts of "Hibiscus rosa sinensis and chemical constituents are used as anti-tumor, antifertility, antiovultory, ant implantation, anti-inflammatory, analgesic, ant estrogenic, antipyretic, antispasmodic, antiviral, antifungal, antibacterial, hypoglycaemic, spasmolytic, CNS depressant, hypotensive and juvenoid activity. As recommended by the "World Health Organization" the traditional health and folk medicine systems have proved to be more effective in health problems worldwide. Hibiscus flower is certain to emerge in the near future as a major player in the growing field of herbal health supplements and medicines both in daily self-care and in professionally managed health care system.

Development and Characterization of Biocolour Fortified Yogurt: A New Pathway towards Functional Foods

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Abstract: *At present, the demand for functional foods is increasing worldwide due to the increased awareness on therapeutic and medicinal properties and their benefits among public because they provide health benefits beyond the provision of essential nutrients. Numerous plant foods or physiologically active ingredients derived from plants have been investigated for their role in disease prevention and health. Natural dyes are those derived from plants, insects, animals and minerals. In this study, color extracted from purple cabbage was used for the development of fortified yogurt, since dairy products or the milk derived products can be considered as functional foods as they are health beneficial for human. The physiochemical and rheological properties of fortified and plain yogurt were checked. Plain yogurt is considered as control. The rheological properties were measured using rheometer which shows a similar flow behavior of Bingham plastic nature. The color stability in terms of anthocyanin content was determined at 560nm at different pH. The polyphenol content (in terms of mg GAE/ gm dry sample) of both fortified and control yogurt were determined spectrophotometrically which shows an increase in values of 1.78 times than control. Thus it can be concluded that the overall acceptability of fortified yogurt is better than the control in terms of sensory analysis, syneresis as well as functional properties.*

Keywords*: fortified yogurt, biocolour, purple cabbage, anthocyanin, functional foods.*

I. Introduction

Functional foods can be obtained in whole or fortified, which provide health benefits by enriching essential nutrients (e.g., vitamins and minerals).Various functional foods have the potential to perform role in disease prevention. But, only a small number of these have had substantive clinical documentation of their health benefits [1]. Dairy products or the milk derived products can be considered as functional foods as they are health beneficial for humans [2]. Functional dairy foods, the probiotics already have positive health image by their traditional use for centuries [3]. The market of functional food increased rapidly [2].

In plant foods, it is found that fruits and vegetables are reach in bio-active compound viz. phenolic compound, carotenoids, flavonoids, anthocyanin, vitamins, higher content of antioxidant and an antimicrobial compounds. In fact the waste peels, seeds can be used as a source of nutraceutical. Thus higher intake of fruits and vegetables offers an effective tool for preventing serious disease like cancer, cardiovascular disease [4].
Colour is one of the most important characteristic of food. Main objective for the addition of colour in food is to make the food more appealing and recognizable. Everyone is sensitive to the colour of the food as it can stimulate or suppress one's appetite [5]. Natural colorants have received increased acceptability, mainly because of the apparent lack of toxicity. Natural colours are sometimes rich sources of antioxidants [6].

Purple cabbage (*Brassica oleracea var. capitata F. rubra*) is a vegetable with good antioxidant capacity. The leaves of this cabbage contain biologically potent anthocyanins [7]. It has anticancerous [8], anti-inflammatory [9] antibacterial [10], anti-diabetic properties[11] as well as it possesses antioxidant, and antihyperglycemic [12]. It is also very rich in minerals, vitamins, anthocyanins, polyphenols, and glucosinolates. It was observed that it contains about 196.5 mg of polyphenols per 100g of raw purple cabbage. It is more unique among the cruciferous vegetables as it provides a good quantity of anthocyanins, which acts as antioxidant as well as anti-inflammatory nutrients. The antioxidant richness of cabbage is partly responsible for its cancer prevention benefits [13] [14].

Anthocyanins are water soluble pigment and they are also known as flavonoids. They provides the bright and attractive orange, red, purple, and blue colours of most fruits, vegetables, flowers and some

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Study of Combined Action of Papaya Leaf Extract, Pomegranate and Lemon – A Review

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ABSTRACT

The main motive of this review study is to focus on the essential components present in papaya leaves, pomegranate juice and sweet lime which is mausambi juice and a result of their combined effect on human health with enhanced beneficial components such as saponins, polyphenols etc. The leaves of papaya are generally considered as waste but their extracts have various health benefits. It contains calcium, magnesium, iron, and vitamins A, C, E, K and B. It is said that Saponin which is a component present in papaya leaves have anticancer capacity as well as reduces excessive oxidative stress. Here, papaya leaf extract can be added to pomegranate lemonade where both these fruits have predominant nutritional value. Pomegranate boosts immunity and aids in digestion. It also has anti-inflammatory properties. It is loaded with Vitamin-C and is also antioxidant-rich. Lemon on the other hand also contains a lot of minerals and vitamins, it also reduces oxidative stress. As a result it is an approach of a health drink having medicinal values. The positive effect of all the above extracts when combined can produce immense health benefits in the human body and can act as suitable nutraceutical with chances of less side effects and allergic symptoms.

KEYWORDS: *Anti-inflammatory, antioxidant, immunity, nutraceutical, saponin.*

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I. INTRODUCTION

The main aim of our study is to use *Carica* papaya leaf extract as a base to utilize its medicinal value and fortify it with commercially available pomegranate lemonade. papaya leaf extract has anti-cancer properties, added to that it also has a lot of health benefits such as- it may aid in digestion as it contains fiber, it has antioxidant properties, it may lower blood sugar level and may increase blood platelets count in dengue affected patients. Therefore, being cost effective, papaya leaf extract may solve a lot of health problems.

Carica papaya is usually cultivated in tropical regions, it's commonly called as papaya in this part of the world and it's from the family "Caricaceae". Papaya grows best in a well-drained, well aerated and rich organic matter soil, pH 5.5 – 6.7 **(Priyanka et al. [1]),** while water logging of soils often results in the death of tress within 3-4 days **(Storey [2])**.The leaves also contain active components such as papin, chymopapin, cystain, ascorbic acid, flavonoids, cyanogenic glucosides that increases the total antioxidant power in blood and reduce lipid preoxidation level. Amount of total

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Fortifications in Ice-cream with Enhanced Functional Properties: A Review

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ABSTRACT

Enrichment of food by the addition of essential micro-nutrients like trace elements and vitamins to food is known as fortification. It can be carried out under initiatives such as Public Health Policy which aims in reducing the number of people with dietary deficiencies within a group of people or population. Ice-creams are well known dessert, and very much in demand among the children. So it is very important to keep its sensory factors in mind and make nutritive additions in it. To meet the demands of the consumers various natural ingredients are used to fortify ice-creams. Works have been done on combining ice-cream with biologically active molecules and produce functionally potential products. There are reports of making natural anti-oxidant ice-cream, experimenting it with cocoa powder, hazelnut, green-tea and ginger extract. Ice-cream fortification with fish-protein powder has turned to be effective in enhancing food value, but studies on its stability during storage and consumer acceptance are highly recommended. Researchers worked on incorporating dietary fibers in ice-cream like wheat, oats, bamboo, apple and orange. Its influence was checked on the basis of rheological, textural, sensory properties and probiotic culture survival of the ice-cream, to enhance the structural characteristics and cultural viability. Addition of Inulin in ice-creams as fat-replacers increased the viscosity and also made it resistant to melting. Hydrocolloids bind water and oil and adding them in ice-creams enhanced the micro-viscosity. Ice-creams were fortified with vitamins and minerals with successful attempts for example Vitamin D3, calcium and zinc fortifications. This study aims to review the various fortifications of ice-cream till date, using different nutritional components, hence fulfilling the nutritional needs of human-beings.

KEYWORDS: *Fortification, Vitamins, Dietary deficiency, Biologically active molecules, Sensory properties, Micro-viscosity, Dietary fibers.*

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I. INTRODUCTION

When any food product is developed, the first few things that must be kept in mind is fulfilling the consumers' expectancy and checking their acceptance of the product. It is a game of combining sensory properties of food with nutritional factors. Any kind of deficiency in the daily dietary routine causes the development of technologically advanced food (enriched in essential micronutrients). Fortification may be defined as the enrichment of food by the addition of essential nutritive. The fortification of foods is often

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A review on microbial-pigment: A good source of biocolour

Shairee Ganguly, Kakali Bandyopadhyay, Purba Dutta and Anirzeet Pramanik

Abstract
In today's world there is a growing demand for healthy food products has lead to the development of "Nutraceutical Food Products". Development of natural food colours or bio-colours is a growing research area to shift the synthetic food colours. Bio-colours have many health benefits properties such as anti oxidant activity, food products stabilization, anti cancer property, etc. The main challenge faced by the industry is the production of natural food pigments in bulk to replace the synthetic colours and also this extraction process from plant origin is time consuming, expensive and the product yield is low. The sources are non-renewable. In this regard, the micro organisms are less expensive and renewable alternative source. In this review paper the competitive study of different microbial pigment is done as well as use of microbial pigment as an alternative of synthetic food pigment and the nutraceuticals properties of those pigments are discussed. This paper also highlights the challenges faced and advanced technologies used in this developing the pigment extracted from microbial sources.

Keywords: Bio-colour, micro-organism, nutraceutical, food pigments

1. Introduction
Colours are a main property of sensory evaluation o any food materials. Since ancient times, human have added food colours to the food products to make the food look more presentable, to make up for the loss of colours during processing and to improve the quality. Customers have since long associated different characteristics of food with colour such as freshness, taste etc. Hence colours have for long served as the sensory evaluating tool. Due to the ease of production in bulk and the cheapness of production, artificial food colours are being used in large scale. However the knowledge about the toxic effect of these artificial food colours among the population is coming to the fore front. Thus a market shift towards development and production of Biocolours has been observed. This shift is more so catalyzed by the recent development of Nutraceutical Food Products as the bio colours are known to contain many beneficial properties and also natural colours are eco friendly. Thus if they replace artificial colour, the production of harmful chemicals polluting the environment will also stop. Now biocolours are generally extracted from plant and vegetable sources which are non renewable sources. However it has been discovered that pigments extracted from micro organisms can be an alternate means of production of natural food colours. Hence a Seemingly vast number of micro organisms found in nature, ease of cultivation of these micro organisms and their medicinal properties adds to the advantage in extraction and production of natural colours from them. Bacteria, Fungi, Algae etc. all produces pigments which can be used for production of bio colours. Among the molecules produced by microorganisms are carotenoids, melanins, flavins, phenazines, quinines (Joshi *et al*., 2003; Pankaj *et al*, 2016) [6, 13].

2. Microbial pigments as food colours
In this earth, uncountable numbers of types of Micro organism are found. Many microbes such as micro algae, bacteria, fungi etc all are known to produce a variety of pigments. As colour extraction from microbial sources have some benefits like, cheaper production, easier extraction, higher yields through strain improvement, less lack of raw materials and no seasonal variations, microbial pigment has become a major source of bio colours (Kamla *et al*., 2012; Dufosse *et al*., 2009) [7, 3]. The health benefits of the microbial pigment such as anti oxidant, non carcinogenic, anti microbial etc adds to the use of microbes. *Flavobacterium sp.* (yellow pigment: zeaxanthin), *Agrobacterium aurantiacum* (pink- red pigment: astaxanthin), *Micrococcus sp.* (different colored pigments, carotenoids), *Serratia marcescens* (red pigment),

A REVIEW ON MUSHROOM: A CANCER ANTIDOTE

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***ABSTRACT*:**Cancer is the leading cause of death worldwide. The current anti-cancer drugs have numerous side effects. In a search for less toxic and effective treatment of cancer some prized mushrooms have been found to have validated anti-cancer properties. Numerous attempts have been made to assess their benefits for commercial purposes and cancer therapy. Certain bioactive molecules including polysaccharides, proteins, glycosides, alkaloids, volatile oils, tocopherols, phenolics, flavonoids, carotenoids, ascorbic acid enzymes, and organic acids which are also anti-tumour agents have been identified from various mushrooms. The anti-cancer potential of mushrooms lies in lentinan, krestin, hispolon, lectin, calcaelin, illudin S, psilocybin, Hericium polysaccharide A & B (HPA & HPB), ganoderic acid, schizophyllan, laccase, etc. Psilocybin mushrooms are used in folk medicine though it's not considered edible. Over 50 mushroom species have been found to yield immunoceuticals with anti-cancer properties for animals including six for human cancers. PSP (Polysaccharide-peptide) over the last 5 year tests have significantly improved quality of life with substantial pain relief besides enhancing immune status in most patients with cancers of stomach, oesophagus, lung, ovary, and cervix. PSK (Polysaccharid-K) and PSP boosted immune cell production, ameliorated chemotherapy symptoms, and enhanced tumours infiltration by dendritic and cytotoxic T-cells. These chemicals have extremely low side-effects, improve the quality of life, and highly compatible with chemo therapy and hence, well suited for cancer management regimens. So here in this review paper, anti-cancer drugs produced by edible & wild both mushrooms & their activity to prevent & cure cancer has been discussed briefly.

Keywords: Anti-cancer Drugs, Folk medicine, Immunoceuticals, cytotoxic T-cells, bioactive molecules.

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A review on extraction of glucose from rice

Anindya Dhar, Poulami Chakraborty, Shalini Chanda and Dr. Anju Paul

Abstract
Carbohydrates are one of the most essential macro-nutrient required for the maintenance of life. Glucose and Fructose act as building blocks of energy. The Human Body consumes carbohydrates in the form of glucose. Glucose is converted to glycogen, a polysaccharide and it acts as a readily available source of energy. Approximately 130 g of glucose is required to nourish the brain cells throughout the day.
Glucose is widely used in food manufacturing industries which include beverage, ice cream, alcohol, confectionary and other fermentation plants.
Studies and researches have shown that extraction of glucose from rice is a cost effective method. Rice is widely consumed and important cereal crop. The three variants of Indian rice HMT, Swarna and basmati have high starch contents. In a nutshell the paper is focused to concentrate about the different methods of glucose production from rice.
The major researches included in the paper are:

1. Glucose obtained from Rice bran by Ultrasound-Assisted enzymatic hydrolysis
2. Isolation of starch from Rice (*Orzya Sativa* L.) by alkali extraction method
3. Efficient Recovery of Glucose via enzymatic saccharification of rice straw with soft carbohydrates
4. Glucose production from rice husk by solid state fermentation method.

Keywords: Rice starch, enzymatic hydrolysis, rice amylase, Solid state fermentation, Saccharification

Introduction
Rice starch isolation is a bit different from other sources of extraction because of it's unique protein compostition. The isolation process mainly consists of the separation of other components like protein, fiber, and lipid. The key factor that one has to keep in mind is that the mechanical damage or amyoletic destruction of the starch granules must be avoided.

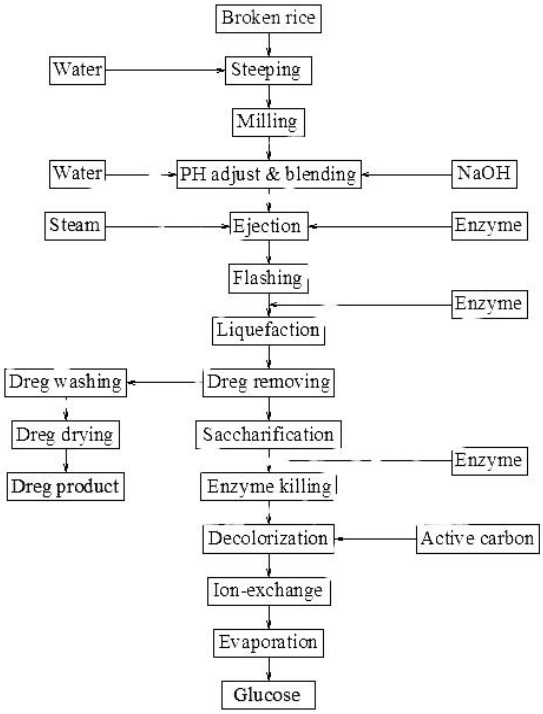

Fig: Steps of Rice Starch extraction

A Relative Study on Utilisation of Fenugreek Seeds for Enhancement of the Antioxidant Activities in Various Baked Products

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Abstract

Fenugreek (Trigonella foenum-graecum L.) is a widely distributed well-known annual plant and has possessed obvious hypoglycaemic and hypercholesterolemia characteristics. In the present study fenugreek seeds and its extracts are utilized for fortification of low nutritional value baked items so as to enhance its nutraceutical properties. It was found that hot extraction and roasted & grinded fenugreek seed extracts had more polyphenol content than cold extraction and raw & grinded fenugreek seed. So it can be concluded that the amount of soluble polyphenols present in fenugreek seeds are increased after heat treatments. Result shows that, the maximum amount of polyphenols is present in three different types of baked items (bread: 0.304±0.002, cookies: 0.291 ±0.003, muffin: 0.345±0.001gm GAE/100gm sample) when fortified with hot extraction of fenugreek seeds.
Therefore, for fortification of heat treated baked food items like bread, cookies and muffins, fenugreek seed and its extracts are good sources of polyphenols.

Key words: *Fenugreek, polyphenol, heat stable, baked food, nutraceutical*

I. INTRODUCTION

Fenugreek (*Trigonella foenum-graecum* L.) is a legume and it has been used as a spice throughout the world to enhance the sensory quality of foods. Fenugreek is well-known for its medicinal properties such as anti-diabetic, anti-carcinogenic, hypocholesterolemic, antioxidant, and immunological activities.

Studies have shown fenugreek seeds to be also a rich source of antioxidants. Polyphenols in fenugreek seeds include apigenin and a number of kaempferol and quercitin glycosides [1] as well as flavonoids; vitexin, tricin, naringenin quercetin and tricin-7-O-β-D-glucopyranoside (Shang *et al*., 1998). The extracts of endosperm husk, and fenugreek seed at about 200mg concentration exhibited antioxidant activity 72%, 64%, and 56% respectively by free-radical scavenging method [2]. The major bioactive compounds in fenugreek seeds are believed to be polyphenol compounds, such as rhaponticin and is ovitexin [3]. *Dixit et al. (2005*) [4]found that fresh leaves of fenugreek contain ascorbic acid of about 220.97 mg per 100 g of leaves and β-carotene is present about 19 mg/100 g. On the other side, it was reported that 84.94% and 83.79% ascorbic acid were reduced in sun and oven-dried fenugreek leaves respectively.

Health benefits of fenugreek seeds include:

- Diabetes Mellitus prevention: Fenugreek powder treatment in patients suffering from mild Non-insulin dependent diabetes mellitus produced marked reduction in blood sugar and serum triglycerides and total cholesterol [5].
- Cancer prevention: The effect of fenugreek seeds observed in induced breast cancer [6], Further, the ethanolic extract of fenugreek showed antineoplastic effect on the growth of breast cancer cells by reducing cell viability, inducing early apoptotic changes, declining the mitochondrial membrane potential and degrading cellular DNA into fragments[7].
- Antioxidant activity: It has been documented in various studies that fenugreek bears potential of a powerful antioxidant in which the presences of flavonoids and polyphenols have been found to be responsible for the same [4]. The exposure of polyphenol rich extract of fenugreek seeds which showed protective effects against hydrogen peroxide induced oxidation by protecting the erythrocytes from haemolysis and lipid peroxidation in a dose dependent manner [8].

This study was carried out with the objective to enhance the antioxidant properties of various baked products made from soft wheat flour on fortification

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Analysis and study on the antioxidant of citrus fruits

Dr. Anju Paul and Debarati Bhattacharyya

Abstract
The term "antioxidant" is mainly used for two different groups of substances: industrial chemicals which are added to products to prevent oxidation, and natural chemicals found in foods and body tissue which are said to have beneficial health effects. Citrus fruits are the source of the second category. They are fruits of the genus Citrus having thick rind and juicy pulp. *Citrus Fruits* are well-known for its nutrition and health-promotion values. In recent years, the antioxidant activity of *Citrus* fruits and their roles in the prevention and treatment of various human chronic and degenerative diseases have attracted more and more attention. *Citrus* fruits are suggested to be a good source of dietary antioxidants. To have a better understanding of the mechanism underlying the antioxidant activity of *Citrus* fruits, we have done these experiments of analysing acidity, moisture content & antioxidant content of 3 citrus fruits (will be discussed below).

Keywords: Citrus fruits, antioxidants, acidity of fruits, health benefits of fruits

Introduction
Citrus is a genus of trees with fleshy, juicy fruits, widely used edible plants belonging to *Citrus* and related genera of the family *Rutaceae* (orange family). Included are the tangerine, citrange, tangelo, orange, pomelo, grape fruit, lemon, lime, citron, and kumquat.
Introduced throughout Europe during the Crusades, they were brought by Portuguese and Spanish explorers to the West Indies, hence they were introduced into North and South America. Commercially they are now the most important group of tropical and subtropical fruits in the world. The fruits are rich in vitamin C (ascorbic acid), various fruit acids (especially citric acid), and fruit sugar. The rind, which contains numerous oil glands, and the fragrant blossoms of some species are also a source of essential oils used for perfumes and similar products. Citrus fruits can be damaged by freezing temperatures, pests (scale insects, rust mites), and various bacterial, viral, and fungal diseases (e.g., citrus canker, greening, tristeza, and melanose).

How can antioxidants benefit our health?
Antioxidants are substances that can prevent or slow damage to cells caused by free radicals, unstable molecules that the body produces as a reaction to environmental and other pressures. They are sometimes called "free-radical scavengers."
Free radicals are waste substances produced by cells as the body processes food and reacts to the environment. If the body cannot process and remove free radicals efficiently, oxidative stress can result. This can harm cells and body function. Free radicals are also known as reactive oxygen species (ROS).
Antioxidants act as radical scavenger, hydrogen donor, electron donor, peroxide decomposer, singlet oxygen quencher, enzyme inhibitor, synergist, and metal-chelating agents. Antioxidant supplements may help reduce vision loss due to age-related macular degeneration in older people.
Foods that are particularly high in antioxidants are often referred to as a "superfood" or "functional food."
Health benefits of Citrus fruits are associated with its high amounts of photochemical and bioactive compounds such as flavonoids, limonoids, phenols, carotenoids, minerals and vitamins. The plant is used in traditional medicine as an antiseptic, antiviral, antifungal, astringent, diuretic, mosquito bite repellent, for the treatment of stomach ailments.

Materials & methods
Three types of Citrus fruits, Lemon (*Citrus lemon)*, Sweet lime or Mosambi (*Citrus limetta*) Orange (*Citrus sinensis*) were taken.

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A veteran vitamin in versatile role: Vit K

Anju Paul, Sreyasree Basu, Mainak Debnath and Amit Kumar Barman

Abstract
Vitamin K is precisely known for its role in blood clotting. The original term vitamin "K" comes from the K in the Germanic word Koagulation meaning the ability to clot blood or prevent hemorrhage. In recent days, new roles for vitamin K have been emerged in the multifarious fields like, brain health, bone, cardiovascular, hormonal and reproductive health etc. vitamin K deficiency is much more likely to occur in infants but in adults person it is also seen. Symptoms include bruising, hematomas oozing of blood at surgical or puncture sites, stomach pains; risk of massive uncontrolled bleeding; cartilage calcification; and severe malformation of developing bone or deposition of insoluble calcium salts in the walls of arteries. In infants, it can cause some birth defects such as underdeveloped face, nose, bones, and fingers. Vitamin K is changed to its active form in the liver by the enzyme Vitamin K epoxide reductase. Activated vitamin K is then used to gamma carboxylate (and thus activate) certain enzymes involved in coagulation: Factors II, VII, IX, X, and protein C and protein S. Inability to activate the clotting cascade via these factors leads to the bleeding symptoms.

Keywords: Vitamin K, coagulation, calcification, phylloquinone, menaquinones, menadione

Introduction
The discovery of vitamin K can be traced back to the research of Carl Peter Henrik Dam at the Biochemical Institute of the University of Copenhagen from 1928 to 1930. In his work on cholesterol metabolism, the Danish biochemist observed a spontaneous tendency to hemorrhage in chicks fed for longer than 2 to 3 weeks on cholesterol- and fat-free chicken feed. This coagulation disorder was combined with lowered prothrombin content (Prothrombin D factor II) of the blood [1-3]. At that time, as none of the hitherto known vitamins (e.g. vitamins A, C and D) were capable of preventing the coagulation disorder, Dam postulated a new, fat-soluble vitamin, which regulates coagulation. The latter was apparently present in green vegetables and liver, as supplementary feeding with these nutrients resulted in normal blood coagulation in the animals. Moreover, Dam successfully treated the chickens' hemorrhages with an ether extract obtained from lucerne (alfalfa). Dam Called the antihemorrhagic vitamin "vitamin K" (after "Koagulation:" coagulation) [4]. In the 1930s, several working groups researched the isolation and identification of vitamin K. At this time, a US American research group working with the biochemist Edward Albert Doisy succeeded in isolating the antihemorrhagic vitamin K and elucidating its chemical naphthoquinone ring structure. In 1943, the 2 researchers, Dam und Doisy, were jointly awarded the Nobel Prize for medicine for the discovery and elucidation of the chemical structure of vitamin K [5, 6].
Vitamin K is a name given to a group of fat-soluble vitamins. They are considered essential cofactors in humans for the production of several proteins that are involved in coagulation homeostasis and calcium homeostasis.
Chemically, the vitamin K family comprises 2-methyl-1,4-naphthoquinone (3-) derivatives. Vitamin K includes two natural vitamers: vitamin K_1 and vitamin K_2. Vitamin K_2, in turn, consists of a number of related chemical subtypes, with differing lengths of carbon side chains made of isoprenoid groups of atoms.
Vitamin K_1, also known as phylloquinone, is made by plants, and is found in highest amounts in green leafy vegetables because it is directly involved in photosynthesis. It may be thought of as the plant form of vitamin K. It is active as a vitamin in animals and performs the classic functions of vitamin K, including its activity in the production of blood-clotting proteins. Animals may also convert it to vitamin K_2.
Bacteria in the gut flora can also convert K_1 into vitamin K_2 (Menaquinone). In addition, bacteria typically lengthen the isoprenoid side chain of vitamin K_2 to produce a range of vitamin K_2 forms, most notably the MK-7 to MK-11 homologues of vitamin K_2.

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Development and characterization of biocolor (*Brassica oleracea var. capitata* F. *rubra*) fortified lime squash

Riya Dasgupta, Chaitali Chakraborty, Kakali Bandyopadhyay and Shairee Ganguly

Abstract
The major pigment of purple cabbage is anthocyanin, responsible for many of the attractive colors, from scarlet to blue. It represents about 196.5 mg of polyphenols per 100g of raw purple cabbage that can be determined spectrophotometrically. Purple cabbage also contains high amount of dietary fiber, carbohydrates and related bioactive compounds. It is thus significant and even essential to find applications in different food products (e.g. Lime Squash). Squash is a non-alcoholic concentrated syrup used in beverage making. It is usually fruit-flavored, made from fruit juice, water, and sugar or a sugar substitute. In this study color extracted from purple cabbage was used for the development of lime squash, packed in glass bottles and sealed hermetically and non-hermetically using wax. The polyphenol of all samples were evaluated spectrophotometrically and expressed in mg Gallic acid equivalent/gm of sample. The light absorbance and color stability of the sample were studied using UV-Vis double-beam spectrophotometer. In this study, the peak of anthocyanin is processed in between 500-600 nm and the maximum peak height of anthocyanin is found at 560nm and color stability is determined within the wavelength range between 550-560nm. The best result in all aspects was found for the lime squash sealed hermetically.

Keywords: purple cabbage, anthocyanin, lime squash, gallic acid equivalent, color stability

1. Introduction
Color is a measure of quality and nutrient content of foods. The objective of adding color to foods is to make them appealing, augment the loss of color during processing, to improve the quality and also to influence the consumer to buy a product. At present, the demand for natural dyes is increasing worldwide due to the increased awareness on therapeutic and medicinal properties and their benefits among public and also because of the recognized profound toxicity of synthetic colors. Natural dyes are those derived from naturally occurring sources such as plants, insects, animals and minerals. Among all the natural dyes, plant-based pigments have medicinal values so are mostly preferred (Chaitanya, 2014). The major pigments present abundantly in purple cabbage are anthocyanin which can be used as a source of natural color. The term anthocyanin was derived from the Greek *anthos*, a flower, and *kyanos*, dark blue. Anthocyanins are the most important group of pigments, after chlorophyll that is visible to the human eye (Harborne *et al*., 1988). Anthocyanins are responsible for many of the attractive colors, from scarlet to blue, of flowers, fruits, leaves, and storage organs (Harborne *et al*., 1988-1993). Being part of flavonoids, anthocyanins are the greatest natural pigments giving blue color in plants and showing antioxidant potential.
Purple cabbage belonging to *Brassicaceae* family is a vegetable with high total antioxidant capacity being also very rich in minerals, vitamins, polyphenols, anthocyanins and glucosinolates. It represents about 196.5 mg of polyphenols per 100g of raw purple cabbage. Purple cabbage also contains high amount of dietary fiber, carbohydrates and related bioactive compounds. Purple cabbage, is more unique among the cruciferous vegetables in providing a big quantity of anthocyanins, which qualify not only as antioxidant nutrients, but also as anti-inflammatory nutrients. The antioxidant richness of cabbage is partly responsible for its cancer prevention benefits (Draghici *et al*., 2013) [5].

2. Materials and Methods
2.1 Materials
2.1.1 Raw Materials Required: Raw materials for the preparation of this squash such as purple cabbage, sugar, limes were brought from local market adjacent to the institution.

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Studies on extraction of polyphenols from food wastes and its utilization for fortification of polyphenols

■ **Kakali Bandyopadhyay, Shairee Ganguly, Chaitali Chakraborty and Anusree Modak**

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■ **ABSTRACT :** Food processing is one of the most important industries over the world, however, byproducts of such industries, mainly organic material must be handled in appropriate manner to avoid any environmental violence. But these by products as well as the waste materials contain some good nutraceutical properties such as presence of polyphenols which can increased the antioxidant properties of the food materials. In this study the polyphenol contents from the wastes of some food materials such as cucumber peels, potato peels, pea nut hulls, pomegranate seed wastes, date seeds, pumpkin seeds are determined in mg GAE/g sample by using different solvents *viz.*, water, ethanol, methanol and acetone as extracting medium. It was observed that, among these samples potato peels, cucumber peels and pomegranate seeds exhibited maximum polyphenol content in water medium, such as 5.14, 6.05 and 4.70 mg GAE/g sample, respectively, whereas pumpkin seeds and date seeds showed maximum polyphenol content in acetone medium, like, 6.06 and 4.40 mg GAE/ g sample, respectively. As water is one of the main ingredients of most of the processed foods, potato peels and cucumber peels wastes can be utilized for fortifications of polyphenols in vegetable soups. It has been observed that the polyphenol content can be increased upto about 2.7 times in case of cucumber peel fortified soups. Therefore, it can be concluded that cucumber peel fortified soups showed the best result considering its functional quality in terms of polyphenol content as well as overall acceptability in terms sensory analysis.

■ **KEY WORDS :** Food wastes, Polyphenol, Nutraceutical, Fortified soups, Sensory analysis

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BANANA PEEL WASTES: POTENTIAL SOURCE OF ANTIOXIDANT IN BANANA CHIPS

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ABSTRACT

Banana are one of the most popular fruit carries a number of beneficial pharmacological effects and comes with a set of variety and it is distributed all over the world. The major by-product of the banana processing industry is the peel causing environmental hazard. High dietary fibre, polyphenolic and related bioactive compounds content of banana peels make them promising for variety of applications in nutraceuticals and medicinal purposes.

In the present study the banana chips with and without peel were prepared by drying (using tray dryer at 60^0C 70^0C, 80^0C) and microwave processing (360, 540, 720, 900 watt). The results showed that moisture loss and shrinkage loss of banana chips increased with increase in time of drying and temperature and wattage of microwave. All types of chips were accepted by sensory analysis with highest gradation was obtained by microwave processed chips without frying. Polyphenol content (mg GAE/gm) of tray dried and microwave dried banana chips with and without peel were investigated which showed that microwave processed banana chips with peel contain highest amount of polyphenols compared to other varieties. Hence consumption of microwave processed banana chips with peel may be useful to combat free radical mediated diseases.

KEYWORDS: Banana Chips, Peel, Polyphenol, Microwave, Sensory Analysis & Tray Drier

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Original Article

INTRODUCTION

In ancient Indian literature the medicinal properties of banana have been documented and found to be effective in cure of many diseases [1]. As a staple fruit, it is available through-out the year which provides livelihood security to thousands of people [2]. In banana processing industry the major waste is the peel, accounting 30% of the fruit which constitute environmental hazard [3]. According to the criteria established by the National Cancer Standard Institute, banana peel extract is classified as non-toxic to normal human cells [4]; therefore, it can be safely utilized as a natural source of antioxidants for value addition. It grows in humid low land to upland tropical areas [5]. Being as a tropical plant, banana protects itself from the oxidative stress caused by strong sunshine and high temperature by producing large amounts of antioxidants [6].

The peel and pulp of fully ripe banana provides good antimicrobial and antibiotic properties [7]. Banana peel is also an underutilized source of phenolic compounds. It accounts 40% of the total weight of fresh banana and these are used as fertilizer or discarded in many countries [8]. It contains various antioxidant compounds such as gallocatectin and dopamine and it is also the rich source of total phenolics and this in turn reflects their

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Textural Analysis of Spongy Indian Milk Dessert (Rasogolla) Fortified with Potato Powder

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Keywords

Potato powder, Rasogolla, Texture analysis, Sensory analysis, Chhana

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A B S T R A C T

Potato is probably the most popular food item in the Indian diet and India is one of the largest producers of potato. Potato is a very rich source of starch. It also contains phosphorus, calcium, iron and some Vitamins C and A. It is vastly consumed as a vegetable and is also used in various forms such as starch, flour, alcohol and dextrin. Besides being used as a daily food item in various vegetable preparations, potato today increasingly finds use in the form of chips or wafers as snacks food. In the present study, potato powder is produced from two varieties of potato like kufri chandramukhi and kufri jyoti. These potato powders are utilized as a binding agent to produce fortified rasogolla sample R1 (kufri jyoti fortified) and R2 (kufri chandramukhi fortified). Control sample (C) of rasogolla is prepared using chhana (a heat and acid coagulated milk protein mass and an Indian equivalent to cottage cheese) only and a market sample (M) is also taken into consideration during comparative analysis of both sensory and texture. It has been found that the highest overall acceptability of about 8.7 (based on 9-point hedonic scale) is observed for sample R2 compared with others. Whereas considering the textural profile like hardness, fracturability, springiness and cohesiveness the sample R2 provides comparable result with other control and market sample.

Introduction

Today potatoes have become an integral part of much of the world's cuisine and are the world's fourth-largest food crop, following rice, wheat, and maize. China is now the world's largest potato-producing country, and nearly third of the world's potatoes are harvested in China and India. Potatoes have high nutritive value and can be consumed in various forms and one of these is potato powder [International Year of the Potato 2008 – The potato (2009)]. Processing of potato into flour is the most satisfactory method of creating a product that is not only functionally adequate, but also remain for an extended period without damage. Potato flour can become a highly viable value added product due to its versatility in function as a thickener and color or flavor improver (Avula *et al.,* 2006; Raj *et al.,* 2008). Several products are prepared by incorporating potato flour with other flours and using the processes like baking, roasting, steaming, boiling and deep fat frying (Gahlawat and Sehgal, 1996).

It also imparts a distinctive, pleasing flavour and improves toasting qualities and can be

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Development and Characterization of Biocolour (*Beta vulgaris*) Enriched Low Calorie Lassi (Yogurt Based Beverage)

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Keywords

Lassi, Betalain, Polyphenol, Freeze-drying, 9 point hedonic scale, Proximate analysis.

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Lassi is a popular traditional yogurt based drink from the Indian Subcontinent. Lassi is a blend of yogurt, water, spices and sometimes fruits. To increase the physical acceptability of lassi, it has been fortified with betalain powder which provides reddish colour. Colour is an important parameter for sensory analysis and consumer preference. However using synthetic colour could be harmful for health. In today's progressive world a shift from synthetic to biocolour is observed. Betalain is a biocolour extracted from beet-root (*Beta vulgaris*). It also increases the polyphenol content of the product which will increase the anti-oxidant property of this beverage. In the present study, effort has been given to reduce the calories of lassi by using zero calorie sweetener, sucralose as it is 600 times sweeter than sucrose. To avoid the heat damage of biocolour, freeze dried powder is used as colorant. The polyphenol content of betalain powder is measured in gallic acid equivalents (GAE) by Folin-Ciocalteau assay using different solvents like methanol, ethanol, petroleum ether and water. Polyphenol content is increased from 755.32 gm/100gm for control lassi to 862.1 gm/100gm sample for fortified lassi. Proximate analysis of the lassi samples and the stability of betalain are also determined. Finally, the sensory evolution is also executed by using 9 point hedonic scale. Thus fortified lassi is prepared with enhanced functional properties as well as its overall acceptability.

Introduction

India is diversified country, famous for its tradition, culture in each field because of agro-climatic zone, language, etc. India is popular for its traditional beverages and foods. These traditional foods are significantly known for their taste and texture, nutritional and therapeutic value. The combination of this traditional knowledge with scientific knowledge will increase the demand of some fermented foods to the health conscious consumers. For example, lassi is a popular traditional yogurt based drink from the Indian Subcontinent. Lassi is a blend of yogurt, water, spices and sometimes fruits. In this present study, to increase the physical acceptability of lassi, it has been fortified with betalain (beet root color).

Again, effort has been given to reduce the calories of lassi by using non-nutritive sweetener, sucralose as it is 600 times sweeter than sucrose and has no calorie.

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RESEARCH ARTICLE

Evaluation of rheological, physicochemical, and sensory properties of apple incorporated yoghurt

Chaitali Chakraborty, Suparna Mukherjee and Srijanee Biswas

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Abstract: Yoghurt, one of the fermented milk products, is a functional food which is popular and acceptable by consumers for several years. Yoghurt is a high nutritious food containing α-lactalbumin, β-lacto globulin, vitamin A, calcium and phosphorus. It is used to aid a variety of gastrointestinal disorders. Apples have higher shelf life (1-2months in refrigerator) compared to many other fruits. Apple consist higher amount of fructose (about 12.6gms) that acts as a natural sweetener which decreases the requirement of added sucrose to yoghurt. In this study a set-type fruit yoghurt was developed by addition of apple pulp. The physico-chemical, sensory and rheological properties of different types of yoghurt were determined. A control (C) was prepared to compare the quality characteristics with Apple Incorporated Yoghurt. The pH of the apple incorporated yoghurt lies between 3.89-4.01 whereas for control yoghurt it is between 4.14-4.34. The addition of apple pulp lead to decrease the pH, syneresis percentage, viscosity and an increase in total solid (TS), water holding capacity (WHC) of the yoghurt. AY3 revealed the highest () WHC (%) whereas the lowest value was observed in case of C. Flow index behavior for C, AY1, AY2 and AY3 were found as 0.57, 0.418, 0.402 and 0.395 respectively. So it can be concluded that apple incorporated yoghurt serves as an excellent food worldwide and can be easily accepted by the consumers.

Keywords: Apple incorporated yoghurt, Physico-chemical analysis, Rheological analysis, Sensory analysis

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Introduction

Yoghurt, which is a commonly fermented dairy product, is obtained from the fermentation of milk by lactic acid- producing bacteria such as *Streptococcus thermophillus* and *Lactobacillus delbrueckii spp. bulgaricus* (Fadela *et al*., 2009). Yoghurt has a variety of probiotics and vitamins and is well received by consumers. Consumption of yoghurt is associated with some health benefits because of the lactic acid bacteria. As there is a lot of sugar and fat in it, it is not suitable for hyperpietics and diabetics. In recent years, consumers' demand for low-fat or nonfat dairy products has increased (Bitaraf *et al*., 2012).

Yogurt is considered as healthy food due to its high digestibility and bioavailability of nutrients and also can be recommended to the people with lactose intolerance, gastrointestinal disorders such as inflammatory bowel disease and irritable bowel disease, and aids in immune function and weight control (Danone, 2013).Addition of flavors would enhance the consumer appeal while produce a variety of products. Flavors can either be added immediately before homogenization or after the homogenization. Yogurts are available in a vast array of flavors including fruit (apple, apricot, black cherry, black currant, blue berry, lemon, mandarin, raspberry, strawberry, peach), cereal, vegetables, chocolate, vanilla, caramel, ginger, etc (Weerathilake *et.al*., 2014; Chakraborty *et.al*., 2017).

Materials and methods

Fruit pulp preparation

Mature ripened apples were brought from local market of Sodepur, West Bengal and washed thoroughly. Then the apples were boiled at 90-95°C for around 5-10minutes. After boiling, the skin, core and seeds of the apples were removed properly. Then

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Potential of raw banana peel as a source of polyphenol in muffins

Chaitali Chakraborty, Kakali Bandyopadhyay, Shairee Ganguly, Bornini Banerjee and Shubham Mukherjee

Abstract
Fresh banana contains about 40% (w/w) peels. Banana peels are a good source of dietary fibres, polyphelnols and some bioactive compounds. But in our society banana peels are considered as waste products. Even in banana processing industries banana peels are not utilized. As a waste material these peels can be hazardous to the environment as they can act as a medium of some harmful microorganisms. In the present study the nutraceutical properties of banana peels are utilized by using them in muffin production. Here banana peels are used as wheat flour substitute and it is added in different proportions (10%, 20%, and 30%) on the wet weight basis of the dough. The muffins were produced in microwave oven at different wattage (360W, 540W, 720W and 900W) as well as in baking oven at 110 ^{0}C temperature for 20 minutes. The polyphenol contents of all types of banana peel fortified muffins (10, 20 and 30% BPM) and control muffins, prepared in microwave oven and baking oven are determined in gm GAE/100 gm of samples by using five different extractions medium viz. acetone, methanol, ethanol, butanol and petroleum ether. It was observed that the polyphenols are mostly soluble in methanol for all types of BPMs as well as for control. For microwave processed 30% BPM the maximum polyphenols content is observed as 7.92 gm GAE/100 gm whereas this value is 7.77 gm GAE/100 gm for baking oven processed 30 % BPM in methanol. The sensory evaluations (by 9 point hedonic scale) of different BPMs are also carried out which showed the maximum overall acceptance for 30% BPM (microwave processed) and 20 % BPM (baking oven processed). Therefore raw banana peel can be utilized as a potent source of polyphenol in various foodstuffs.

Keywords: Banana peel muffin (BPM), polyphenol content, microwave processed, baking oven processed, sensory analysis

1. Introduction
The fruit and vegetable wastes (e.g. peels, seeds) are the non-product flows of raw materials whose economic values are less than the cost of collection and recovery for reuse; and therefore discarded as wastes. Phenolics are found in a plenty of plants and consist of an aromatic ring within the molecular structure (Singh *et al.*2012) [10]. The agro-residues cannot be regarded as the wastes but become an additional valuable resource to augment existing natural materials. Recycling, reprocessing and eventual utilization of food processing residues offer potential of returning these by-products to beneficial uses rather than their discharge to the environment which cause detrimental environmental effects. Banana fruits contain various antioxidants such as gallocatechin and dopamine. *Musa sapientum* which is commonly called banana is a herbaceous plant of the family *Musaceae*. Being as a tropical plant, banana protects itself from the oxidative stress caused by strong sunshine and high temperature by producing large amount of antioxidants. Interestingly, banana peel extracts have also been found to contain a high capacity to scavenge 2, 2-diphenyl-1-picrylhydrazyl (DPPH•) and 2,2′-azino-bis (3-ethylbenzothiazoline) -6-sulfonic acid (ABTS•+) free radicals (González-Montelongo *et al.*, 2010; Kedare and Singh, 2011) [4, 6]. Moreover, the extraction of antioxidants from banana peels is a great way for waste management because the main by-product from banana processing industry is its peel (Anal *et al*., 2014) [2].
Sundaram *et al*., 2011 [12], reported that the unripe banana peel sample had higher antioxidant potency than ripe and leaky ripe. Banana peel extract is classified as non-toxic to normal human cells criteria established by the National Cancer Standard Institute. (Anjum, *et al.* 2015), therefore, it can be safely utilized as a natural source of antioxidants and enzyme to cure disease.
Banana is a highly perishable and bulky fruit, which requires processing into a more stable and convenient form.

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Change in physicochemical properties of edible oil during frying: A review

Kakali Bandyopadhyay, Chaitali Chakraborty, Suravi Chakraborty and Shairee Ganguly

Abstract
Edible oils from plant, animal, or synthetic origin, are used in frying, baking, and other forms of cooking, and in salad dressings and bread dips. Plant-derived edible oils consist of carboxylic acids with long hydrocarbon chains, in contrast to petroleum-based oils which lack the carboxyl group on the end. The carboxyl group makes the oils edible, providing a site for human enzymes to attack and break down the chain in a process called beta-oxidation. There are a wide variety of cooking oils from plant sources such as olive oil, palm oil, soybean oil, canola oil (rapeseed oil), corn oil, peanut oil and other vegetable oils, as well as animal-based oils like butter and lard. This paper incorporates a comparative study of different types of frying oils by their physicochemical properties and compositional qualities. There are numerous health benefits of frying oils which has been covered in the paper along with the future of edible oils in India.

Keywords: Edible oils, carboxyl group, physicochemical properties, health benefits.

1. Introduction
Lipids and triacylglycerol naturally occur in oils and fats. Their chemical composition contains saturated and unsaturated fatty acids and glycerides. Edible oils are vital constituents of our daily diet, which provide energy, essential fatty acids and serve as a carrier of fat soluble vitamins (Erum Zahir *et al*., 2014) [26]. Cooking oil is typically a liquid at room temperature, although some oils that contain saturated fat, such as coconut oil, palm oil and palm kernel oil are solid.

Fat frying is one of the oldest and popular food preparations. Fried foods have desirable flavour, colour and crispy texture, which make deep-fat fried foods very popular to consumers. Frying is a process of immersing food in hot oil with a contact among oil, air, and food at a high temperature of 150 to 190^{o}C. The simultaneous heat and mass transfer of oil, food and air during fat frying produces the desirable and unique quality of fried foods. Frying oil acts as a heat transfer medium and contributes to the texture and flavour of fried food (Hassan A. Mudawi *et al*., 2014) [15]. Numerous types of edible oils of plant and animal origin are used in frying, depending on regional availability. Palm oil is often used in Southeast Asia, coconut and groundnut oil in the Indian subcontinent, and olive oil in the Mediterranean region. During the last five decades, the Western food industry has become increasingly dependent on the frying process to manufacture a variety of snack foods. Fried foods such as potato chips, french fries, and fried fish and chicken have gained worldwide popularity (Farkas B.E. *et al*., 1996) [10].

According to Erum Zahir, the quality of Corn and Mustard oils was analyzed by evaluating physicochemical properties such as density, viscosity, boiling point, peroxide, iodine and saponification values. Results are presented in Table 1. Oils with lower values of viscosity and density are highly appreciable to consumers. In order to design an advanced technological process these properties are very important parameters.

From the results obtained as presented in Table 1 the saponification value of palm kernel oil (280.5±56.1 mg KOH/g) is higher than those obtained for coconut oil (257.5±6.5 mg KOH/g) and groundnut oil (191.5±3.5 mg KOH/g) and since the higher the saponification value, the higher the unsaturated level of the oil, it can thus be inferred that palm kernel oil possess more unsaturated fatty acids than groundnut and coconut oils. It also indicates that the molecular weight of palm kernel oil is less than those of groundnut and coconut oils (Theodore, 1983) [23]. The iodine value obtained for palm kernel oil (i.e., 15.86±4.02 mgKOH/g) is also higher

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Neutraceutical potential of some rare fruits & vegetables: A Review

Chaitali Chakraorty, Kakali Bandyopadhyay, Riya Dasgupta, Abhijit Ghosh, Poulami Mitra, Tania Paul and Abhik Dutta

Abstract
Vegetables are considered essential for well-balanced diets since they supply vitamins, minerals, dietary fiber, and phytochemicals. Each vegetable group contains a unique combination and amount of these phyto-nutraceuticals, which distinguishes them from other groups and vegetables within their own group. In the daily diet, rare vegetables can add more nutrition as well as play significant role in preventing various chronic diseases. Rare fruits and vegetables mainly include Broccoli, Purple Cabbage, Kiwi, Fig, Pomelo, Star fruit and many more. All of these are rich source of vitamins, minerals and carbohydrate with low fat content. Mainly they are preventive against different cancer and tumors that lead to cancer. The promotion of healthy rare vegetable products has coincided with a surging consumer interested in the healthy functionality of food.

Keywords: Rare fruits and vegetables, cancer, antioxidants, phytochemicals, and phyto-nutraceuticals

Introduction
The term vegetable refers to edible part(s) of a plant consumed raw or cooked, generally with a main dish, in a mixed dish, as an appetizer or in a salad. Vegetables include edible stems and stalks, roots, tubers, bulbs, leaves, flowers, some fruits, pulses (mature beans and peas), fungi (mushrooms, truffles), algae (seaweed) and sweet corn and hominy (cereal grains used as vegetables). Vegetables help to meet up major portion of the diet of humans through worldwide and play a significant role in human nutrition, especially as sources of phytonutraceuticals: vitamins (C, A, B1, B6, B9, E), minerals, dietary fiber and phytochemicals (Quebedeaux *et. al.* 1990-1999) [18]. Some phytochemicals of vegetables act as strong antioxidants and plays significant role to reduce the risk of chronic disease by protecting against free-radical damage, by modifying metabolic activation and detoxification of carcinogens, or even influencing processes that alter the course of tumor cells (Southon *et al*, 2000-2009) [23]. According to the 2007 World Health Report unbalanced diets with low vegetable intake and low consumption of complex carbohydrates and dietary fiber are estimated to cause some 2.7 million deaths each year, and were among the top 10 risk factors contributing to mortality (Dias, 2011) [5]. Especially, rare vegetables contributes significantly overall good health, improvement of gastrointestinal health and vision, reduced risk for some forms of cancer, heart disease, stroke, diabetes, anemia, gastric ulcer, rheumatoid arthritis, and other chronic diseases. Some rare vegetables are as follows: Broccoli, Purple Cabbage, Kiwi, Fig, Pomelo, Star fruit. Cruciferous vegetables (Brassicacea or Cruciferae family) which include, cabbage, brocolli, cauliflower, Brussels sprouts, kales, kailan, chinese cabbage, turnip, rutabaga, radish, horseradish, rocket, watercress, mustards, among other vegetables, provide the richest sources of glucosenolates in the human diet.

Different Rare Vegetables
1. Broccoli: *Broccoli* ("*Brassica oleracea var. italic"*) is a Cruciferous green leaf Cole vegetable. This plant is native of Italy, but can be successfully grown in India also. It is a rich source of valuable nutrients Vitamin A, C & riboflavin. It contains high amount of Iron and Calcium and is a non-fattening food and possesses various medicinal properties as well (Mishra and Mukherjee, 2012) [15]. Broccoli grows best in temperature ranging between 18 ˚C and 23˚ C. Sprouting broccoli has a larger number of heads with many thin stalks. It is planted in May to be harvested during the winter in areas with temperature climates. Romanesco broccoli has a distinctive fractal appearance of its heads, and is yellow-green in color. It is technically the Botrytis (Cauliflower) cultivar group. Purple cauliflower is a type of broccoli

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Utilization of various seeds: A review

Chaitali Chakraborty, Kakali Bandyopadhyay, Chandralekha Bhowmik, Prostuti Chakravorty, Rupsa Roychowdhury, Shubhapriya Samanta and Manasi Roy

Abstract
Seed, known to be an embryo possessing part of a plant, enclosed in a protective outer covering, does not have much utilization known to us. Seeds which are generally thrown away as a waste product have various benefits hidden among themselves. In this review paper, seeds and their different utilizations have been highlighted. We see that seeds, because of their concealed polyphenols and antimicrobial activities, serve us with various medicinal purposes. By-products such as seed flour and seed oil derived from them are enriched with nutrition value and antioxidant properties. Thus, instead of being wasted and withered, proper utilization of seeds should be done.

Keywords: embryo, polyphenols, antimicrobial activities, seed flour, seed oil

1. Introduction
Seed has been considered as a waste product dumped from households or fruit/vegetable processing industries. But seeds have found their utilization in food, pharmaceutical and cosmetic industries for their antioxidant and medicinal values. Besides, seed can used for processing of seed flour, seed oil and can be utilized as a source of various polyphenols and flavonoids. The parts of the plant most commonly used for the therapeutic purposes in the "Alternative Medicinal" systems are the seeds which are contained in an inflated capsule formed from the united follicles containing considerable amount of oil having pungent and bitter taste. (Padhye *et al.* 2008). (Umbelliferae). Essential oil of fennel is used as flavoring agents in food products such as beverages, bread, pickles, pastries, and cheese. It is also used as a constituent of cosmetic and pharmaceutical products (Piccaglia *et al.*, 2001) [75]. Herbal drugs and essential oils of fennel have hepatoprotective effects (Ozbek *et al.* 2003) [71], as well as antispasmodic effects. They are also known for their diuretic, anti-inflammatory, analgesic and antioxidant activities (Choi, E, 2004) [31] (Anand *et al*, 2008) [5] reported that fennel seed possesses anticancer activity.
In general, the use of food parts usually discarded by industries adds nutrients to various preparations. (Storck *et al.* 2013) [84-89], elaborated preparations using papaya seed cake and papaya peel jam and observed an increased fiber content and sensory analyses were conducted. *Sesamum indicum* L. (Pedaliaceae) is an annual shrub with white bell-shaped flowers with a hint of blue, red or yellow with branches or without branches. It is grown for the production of seeds which is rich in oil content. (Chakraborty *et al.* 2008). Commonly the seeds are used primarily as a spice and food preservative. In folk medicinal practices they are ingested with food or mixed with honey and are primarily used as lactogogues, carminitative and antihelmnthic agents. The seeds have also been used as diuretics, anti-hypertensive, muscle relaxants and as immunity enhancers in immune- compromised people. Importantly, the seeds have been reported to be safe when used orally in moderate amount in food (Der Marderosian. *et al,* 2005) [34]. Several beneficial pharmacological effects have been attributed to various crude or purified components of these seeds including antihistaminic (Chakravorty, 1993) [30], antihypertensive (Zaoui *et al.*, 2000) [98], hypoglycemic (Al-Hader *et al.*, 1993) [1], antifungal (Khan *et al.*, 2003) [51], anti-inflammatory (Al-Ghamdi, 2001) [9] along with significant anti-neoplastic (Worthen *et al.*, 1998) [96] activities. These studies collectively provide early indication that further development of agents derived from black cumin seeds could be useful in modern medicine.
The chemical composition of fenugreek seed (FS) has been thoroughly studied and its medicinal properties are associated with its phytochemicals such as galactomannans, phenolic compounds, alkaloids, proteins, vitamins (A, B1, C and nicotinic acid) and volatile oils

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A Study on Antimicrobial Properties and Medicinal Value of *Adhatoda vasica, Centella asiatica, Paederia foetida, Nyctanthes arbor-tristis, Ocimum tenuiflorum*

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A B S T R A C T

The use of various herbal remedies and preparations are described throughout human history representing the origin of modern medicine. Herbal medicine is also called botanical medicine or phyto-medicine, and is defined as the use whole plants or part of plants to prevent or treat illness. Medicinal plants constitute an important component of flora and are widely distributed in India. The pharmacological evaluation of substances from plants is an established method for the identification of lead compounds which can leads to the development of novel and safe medicinal agents. The importance of medicinal plants and traditional health systems in solving the health care problems of the world is gaining increasing attention. Because of this resurgence of interest, the research on plants of medicinal importance is growing phenomenally at the international level, often to the detriment of natural habitats and mother populations in the countries of origin. The study on antimicrobial and medicinal values of: *Adhatoda vasica (vasaka), Centella asiatica (thankuni), Paederia foetida (gadal), Nyctanthes arbor-tristis (shiuli),* will help us to understand their anti-microbial property so that they can be used in more effective and efficient manner for pharmacological purposes.

Introduction

World Health Organisation (WHO) has defined medicinal plants as plants that contain properties or compounds that can be used for therapeutic purposes or those that synthesize metabolites to produce useful drugs. Medicinal plants constitute an important component of flora and are widely distributed in India. The pharmacological evaluation of substances from plants is an established method for the identification of lead compounds which can leads to the development of novel and safe medicinal agents. The importance of medicinal plants and traditional health systems in solving the health care problems of the world is gaining increasing attention. Because of this resurgence of interest, the research on plants of medicinal importance is growing phenomenally at the international level, often to the detriment of natural habitats and mother

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CLIMATIC CONDITIONS REQUIRED AND FACTORS AFFECTING THE PRODUCTION OF SWEET POTATO

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ABSTRACT:

Sweet potato is a subtropical crop. It requires moderate temperature ranging between 21-26°C. It requires the average temperature 75°F (24°C) for growth. The other factor that also have significant effect on growth are abundant sunlight, warm nights,annual rainfall [(750-1000mm), with minimum range of 500mm in growing time]. Climate change such as global warming, elevated CO_2 concentration, high temperature etc affects sweet potato production worldwide. Elevated CO_2 cause malformation of tuber. High temperature also causes reduced yield. Overall climate change affects sweet potato greatly.

KEYWORDS: Climate Change, Production, Yield, Carbon-di-Oxide & Temperature

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Original Article

INTRODUCTION

Sweet potatoes can be grown where there is a long frost-free period with warm temperatures in the growing season. The plant does not tolerate frost .Sweet potato requires moderate temperature (21-26^{o}C, so, it can be grown in every month but in different countries worldwide. Sweet potatoes require plenty of sunshine, but shade causes yield reduction. However, sweet potato is intercropped with other seasonal crops like pigeon pea, maize, etc (Nedunchezhiyan *et al.*, 2010) and to fulfill the objective of intensification of crop and to gain the profit at a maximum level, it can be grown as an intercrop. At initiation stage (0-60) days, sweet potato is very much sensitive to draught and water-logging. If it is not maintained properly, then it causes rotting of tuber and reduced growth of storage root. (Nedunchezhiyan and Ray 2010). Sweet potato is very much affected by saline and alkaline condition of the soil. (Dasgupta *et al.* 2006, Mukherjee *et al*. 2006).

FACTORS AFFECTING THE PRODUCTION OF SWEET POTATO

Concentration of CO_2

Increased rates of photosynthesis, WUE, and NUE on plants grown at elevated CO_2 concentrations not only alter biomass, but also change the plants elemental composition. The majority of studies looking at these effects have focused on the foliar portion of crops, or the seed or grain of major global crops and resulted in increased carbohydrate concentration and decreased protein and mineral concentration (Seneweer and Conroy, 1997; Fangmeier et al., 1999; Prior et al., 1998). Loladze (2002) reviewed 25 studies that looked at changes in mineral concentration of plants grown under slightly elevated (twice ambient) CO2 concentrations. He found average percent decreases in N, P, K, Ca, S, Mg, Fe, Zn, Mn, and Cu for all foliar plants, and decreases for all minerals except K (.86% increase) and Cu (no data) for wheat showing the same trends found for wheat mineral

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Development Of Papaya Peel Flour Based Cookies And Evaluation Of Its Quality

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***Abstract*—The focus of this research project was to develop papaya peel flour from raw papaya and utilizing the papaya peel flour for the development of value added cookies. Fresh papaya was blanched, peeled, cut into small pieces, further washed and treated with sanitizer, tray dried and finally grinded to powder form. Prepared papaya peel flour was evaluated for chemical analysis. In the present study the moisture (%), ash (%), acidity, fat (%), insoluble solid(%),soluble solid(%), protein content(%), vitamin C, total fiber, total carbohydrate and antioxidant content of papaya peel flour were estimated as 13.63%, 5.25%, .163% ,.1%, 80%, 20%, 8.64%,.22I.U, 33.5%, 38.88% and 514.6mg/100gm respectively. Papaya peel flour fortified biscuits were formulated by incorporating 5%, 7.5% and 10% papaya peel flour with ordinary flour in the present investigation. Experimental result revealed 5% peel flour formulated cookies gives the best results in terms of physicochemical quality. The physicochemical and nutritional quality parameters viz. moisture(%), ash(%), acidity, fat(%),vitamin C, insoluble solid (%),soluble solid(%),protein content(%),total fiber, total carbohydrate and antioxidant content of all fortified varieties of cookies were determined. The best result obtained for 5% papaya peel fortified cookies and was determined as 10.35%, 4.5%, 0.02%, 15.4%, .31U, 85%, 15%,9.3%,.017%,60.43% and 9gm/100gm respectively. Now the experimental result revealed that papaya peel flour fortified cookies contains significant amount of protein and antioxidant in comparison to it's ordinary counterpart which improves it's nutritional characteristics. Sensory evaluations of all fortified varieties were also carried out and it was found that 5% papaya peel flour blend for cookies formulation was acceptable. Therefore 5% papaya peel flour based formulated cookies proves enhanced nutritional properties, physicochemical characteristics and organoleptic attributes.**

Keywords—Papaya peel flour, value addition, antioxidant, sensory evaluation, nutrition

I. INTRODUCTION

Papaya (Carica papaya L.) belongs to the family Caricaceae. Papaya (*C. papaya L.*) is the fourth most important tropical fruit around the globe (Scheldeman et al. 2007). The major producers of papaya in the world are Australia, United States, Philippines, SriLanka, South Africa, India, Bangladesh, Malaysia and a number of other countries in tropical America (Anuara et al. 2008).Some of the active compounds in papaya are ascorbic acid (108 mg/100 g), antioxidant, β-carotene, α-tocopherol, flavonoids, vitamin B1, papain and niacin (Leontowicz et al. 2007; Lim et al. 2007).Fruit processing results in large amounts of waste as by products such as peels and seeds. Thus, by-products and its further utilization in the production of food additives or supplements with high nutritional value have aroused great interest since they are high-value products It is very much interesting that such wastes are important sources of sugars, minerals, organic acids, fibber, and phenolic compounds that have a wide range of pharmacological activities, which include antitumor, antiviral, antibacterial, cardio protective, and ant mutagenic activities (Djilas et al., 2009). In addition, these components help to maintain health and prevent diseases such as cancer, cardiovascular and many other degenerative diseases (Larrauri 1999).Fortification of these nutritional constituents in processed food products is a way to increase daily cooking by creating new recipes such as jellies, pies, juice, and pastries, in addition to nutritionally enriched diets, providing more fibber, vitamins, and minerals (Storck et al., 2013). (Storck et al., 2013) elaborated preparations using papaya seed cake and papaya peel jam and observed an increase d fiber content and sensory analysis were conducted. In many countries, cookies are generally consumed and it could be considered as a vehicle for nutrient transfer (Arshad et al. 2007). A number of studies have been reported on the improved nutritive value of high protein cookies made of composite flour such as a blend of soybean (Shrestha and Noomhorm 2002) and unripe banana flour replacing the wheat flour. Rice and black bean extruded flour replacing wheat flour can be considered as a good source of protein and fiber and reducing lipids in cookies (Lund and Smoot 1982). This study was conducted with the objective to produce and analyze papaya waste (peel) flour for its chemical constituents with the purpose to use it in preparations and formulations of nutritionally enriched value added cookies in terms of nutritional properties, physicochemical characteristics and organoleptic attributes.