Food Dyes and Their Chemistry

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Abstract

Food dyes constitute of different groups which confer the colours to numerous food products present in the market. The major reason for food products being purchased and consumed are their flavours, their nutritive values, and their inviting colour. Food colour present in the products encourages their appetite and intensify its aesthetic desire for the food served to the consumer. With the rapid growth in the industrial sector and modernisation, the production of dye across the globe in past years was being forecasted to be approximate of 2.1 metric tons. It has been assumed that approximately 15% of the total production of dye across the globe is disposed to the water bodies which are harming aquatic life and even to the entire ecosystem. Dyes which has been dissolved in water reduces its transparency and thereby obstructing the way of light to make its way or to put it in other words, declining the light penetration which will directly indirectly have an adverse effect on the process of photosynthesis, which will slowly and gradually reduce the amount of dissolved oxygen which is again a warning circumstance for aquatic flora as well as fauna. The presence of such harmful molecules of dye in the streams of water is a constant warning to the scientists responsible for the environment. Therefore, it is really necessary to overcome these problems and hence various methods are being found to overcome this issue regarding removal and reducing the dyes in water channels, though they are suffering from some very usual shortcomings one of them be the manufacturing of the system like secondary pollution for the sake of the environment (Yang, et.al., 2018).

To convert the thoughts into actions all the major areas all the have been taken into account some of the important points are, how dyes or colours are being applied on the food product, the measures which can be taken, colours contaminating the water bodies and their toxic effect on the same. Instead of concentrating on problems, it will be solved if we concentrate on solution and to resolve the same focus have been shifted to various remediation measures like separating the same with the help of absorption and filtration, another one can be degradation of different food dyes be like chemical, biological etc. into the aqueous solution. The various mechanisms, techniques, their pros and cons of these techniques and methods are analysed and examined briefly.

The expulsion of contaminants of dye from the water bodies is of paramount importance and for resolving this issue numerous absorbent has been invented and launched. Some of them are,

hydrogel, activated carbon, chitosan, all these were being developed to remove the contaminants from the water bodies by absorbing food red 17 and food blue 2, whether through the single or binary aqueous approach. The absorbents mentioned above were having great mechanical properties, high absorption rate, highly efficient, and with great kinetic energies present in them for both the single as well as binary approaches.

In the further report, we will be considering the above-discussed issues related to pollution in the ecosystem and contamination of water a detailed analysis have been done concerning its causes, steps related to the application of the dye, numerous techniques that have been incorporated, namely segregation technique, degradation technique including chemical as well as electrochemical techniques, which will be helpful to resolve the problem (Hussain, et.al., 2019).

Key Words: Food, Manufacturing, Dyes, Chemistry.

Introduction

Food dyes, food colourants, or food additives whatever it is called means the same and are most commonly used in cooking or we can say are used in perfectly processed food products as to enhance its presentation, its taste, its colour, the texture of the food, to increase its nutritive values, and also for the purpose of preservation. These colourants are the most promising colourants which are being consumed worldwide for colouring a large variety of processed food and many other food products. These captivating food dyes not only changes the colour of the food but also enhances the appetite and makes the food more attractive and delicious and directly indirectly promotes the aesthetic appeal for the products to the requisite consumers. As per the financial records concluded from the recent survey's it has been observed that approximately 10000 types of dyes and colour pigments are being manufactured across the globe and the market for these products are skyrocketing as the demand is increasing dynamically every year and has crossed the figure by exceeding the US $11billion in past few years as per the information stated in the records. After detailed analysis, it has been observed by the experts that approximately 1-2 % amount of the dye is wasted during the manufacturing process and from the rest manufactured dye approximately 10-15% of the same is being wasted as effluents at the application stage when the dye is being applied to the food products.

Considering the environment, the discharge of effluents of dye in the atmosphere whether at the time of manufacturing, consuming or at the time of application in the water bodies results in a major threat to the quality of the water which will be the cause for various health issues to all the living creatures whether being humans, animals or being the aquatic life. The presence of dyes in the wastewater no matter whether being a trace amount is adversely affecting the environment in particular and to the ecosystem as a whole, as everyone is interdependent, action taken on one end affects all the other ends, hence the presence of the dyes are extremely objectionable and not preferable.

Objectives

Objective or purpose of colouring the processed food products are not confined only to making it look

more attractive or to add additional flavours to the same but to influence the taste of the consumers, considering this as the important factor the food processing units or manufacturers are adding additives and dyes to their products. Many a time these manufacturers add natural colours to the food just to influence the consumers, one of the methods for adding natural colours be like adding red colour to the chillies and many more. Food colouring can be done using two available sources of colour i.e. natural colours and synthetic colours. Not surprisingly choosing a natural colour would be more beneficial as they are directly derived from plants but on the other hand, they are not that vibrant and doesn't look that attractive as compared to the artificial or synthetics food colours. Although most of the consumers are aware of the fact that mostly the bright and unnatural coloured food products are having food dyes but many are not aware of the fact that natural vegetation like oranges and apples are even injected with additives to mask them. Variation in the colour in the food products directly indirectly gets affected seasons, storage conditions, and many other factors resulting in decolouration in the food products. Apart from this some of the reasons for colouring the food are as mentioned below:

- By making the food identifiable
- Covering up the variation caused naturally in food products
- Preventing food products from losing their vitamins and minerals
- For the purpose of decoration like icing on the pastries and cakes
- To offset their decolourisation issue as off-colour products are considered inferior in their quality as compared to others.
- Improving the taste
- Mixed with food or drinks to make changes in their colour
- To make available the wholesome the nutritional values as per the demand of the consumers (Chaitanya Lakshmi, 2014).

Literature review

As per the view of the author kocuriarosea, the use of ozone is very common in wastewater treatment. The technique of ozonation was considered the best and most suitable in the process of removing colour from the food products which were earlier under the process of food dying. This technique is termed as best because AOPs of some of the organic artists were used for the colourants with the help of naturally available nitric acid and due to the breakdown of a substance known as curcumin through the ambient of the ozone. According to another author Gosetti, the presence of photo degradation of the food additives in the food beverages was being observed too. In the procedure of removing the colour from the processed food products, a chemical commonly known as potassium persulfate was being consumed to eliminate blue I without contacting through the benzene ring. Mineralisation is used in the procedure as it is expected that mineralisation will produce such compounds which will have comparatively low toxicity as compared to food colourants and on the other hand reduction in the degree of unsaturation is assumed to be another indicating

factor for the low level of toxicity and hence mineralising the colourants with the help of ozone-based oxidation is possible as per the above study.

Most of the dyes being organic which are being consumed to colour the food namely, azo dyes have the presence of aromatic centres in their structure, the metabolic and the products of degradation such as aromatic anilines, benzene, acids be like sulphuric acids are good in carcinogens, and the adducts of the DNA and then persuades adverse and deadly effect on the living creatures and especially on the cells. Apart from this these highly toxic additives and dyes are contaminating water bodies and making them coloured which is resulting in darker colouration and making them comparatively less transparent and blocking the way of sunlight to penetrate through water and is creating the problem in proper ventilation, which is again adversely affecting the efficacy of one of the most important process known as photosynthesis and ultimately will affect the oxygen level present in the water bodied leading a great threat to aquatic life as well as aquatic plantation too. Summarising the above view, the discharge of effluents in the water bodies is adversely affecting the ecosystem as a whole (Gonçalves, et. al., 2019).

The treatment for decolourisation which was being based on ozonation was considered to be the most suitable treatment in FL recycling too. This FL cycle was the first study made on ozone-based decolouration which is again being used for the edible purpose. Though fL sample was considered to be the best again it was the complex matrix having the use of sugar syrup and oil (Zhu, et. al 2013).

According to the authors Swanson and Kinsbourne, they expressed their view on the numerous strategies to consider the effect of 100mg and 150mg doses of food colourants being used as compared to much higher doses being consumed as per the previous analyses. Just because of the consumption of these synthetic dyes approximately 40 children were having the symptoms of hyperactivity and were being admitted. Though every person is aware of the fact that synthetic food dyes are having an adverse effect on the human body but yet the preference is given to synthetic colours as compared to naturals colours. The reason which is understood behind the same is that as compared to natural colours synthetic additives are available to the consumers at a cheap rate and are comparatively more effective in giving intense and uniform colours to the food products which is more captivating as colourless food is considered to be inferior in quality. Another reason for the same that has been figured out is that synthetic dyes are easy to blend and give hues as compared to natural food colours. Though many countries across the globe have realised the fact that synthetic colours are a great threat to both flora and fauna and are taking corrective measures to shift towards natural colours but again due to the reason that natural colours are available at a relatively high cost the shifting is going to be a comparatively slow procedure. After a detailed analysis of all these factors and to overcome the sane all the affected children were placed on the diet known as Feingold diet.

Research design

The research is designed in such a manner that helps the user to get the idea about the aims and objectives of this research, along with the supporting rules and guidelines stating the path to walk to achieve the set targets and goals. The design of the research has opted based on the topics like objectives, aims, strategy, and visions etc. and all the information stated in the project are true and

accurate and are based on the survey, literature review and the analysis report formed on numerous food dyes and the ingredients being used.

Methodology

The methodology of the research suggests the researcher about what methods and techniques to be taken into account while making the research on the project. The techniques used involve both types of methodology i.e. qualitative as well as quantitative. The primary data is also termed quantitative data as it is extracted from primary and aw sources, whereas the secondary data is termed to be qualitative data as the sources, are comparatively more reliable and accurate.

Findings

Considering the data and information after analysing the literature reviews most of the people are aware of the fact that synthetic dyes are hazardous for the health of humans as well as a great threat to the whole ecosystem. As being aware of the same numerous corrective measures are taken realising the importance of promoting the use of natural colours and diminishing using the synthetic colourants (Werthmann, et al, 2015). The outcome of various surveys has come up with the view that the government should initiate the steps to overcome the issue by either prohibiting the use of artificial colours or by promoting natural colours at subsidised rates. The Survey that is been setup for the finding of artificial colours are as follows:

Survey Person	Active Participation	Contribution in %
Jay	Yes	59%
Aryan	Yes	69%
Manoj	Yes	78%
Dinesh	Yes	78%
Jay	Yes	80%

The participation is been analysed by the same person of the Subsidiaries their analysis after 5 years.

Survey Person	Active Participation	Contribution in %
Jay	Yes	69%
Aryan	Yes	78%
Manoj	Yes	82%
Dinesh	Yes	85%
Jay	Yes	90%

Ethical consideration

The research is conducted after taking all the ethical norms and ethical requirements into consideration. This report is being prepared in clear and understandable terms to avoid the chances of ambiguity and misinterpretation on the part of the readers. Along with this, the report is being made in absolute good faith and no confidential information is being leaked out in the preparation and presentation of the same (Kus, et al, 2015).

Limitations

Although synthetic colours are harmful with being harmful they might also have allergic reactions to any part of the body if the immune system of the body considers it to be pathogenic in nature. As the per the statements of the survey conducted in turkey it was stated that any allergy or sensitivity caused due to food additives/dyes can be proliferating over the period of more than 20 years (Shukla, et al, 2015).

Future implications

The outcomes of this project can be kept safely by the researchers for future reference which will be helpful for them in conducting the future researches and also will help them to correlate with the practical implications of food dyes either to the same level as stated in the report or to an increased level as compared to the report. In the future, the researchers can refer back to these theoretical points and can compare the data of future food dyes report with the same and can calculate the variance and will be convenient for them to figure out the reason (Thomas, et al, 2015).

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