PIGMENTS AND FLAVORS

Hi,,,, Everybody I welcome you all for the presentation on “Pigments and Flavors” The present lecture is divided in to two parts

1. Pigments

FURTHER EACH SECTION DIVIDED IN INTO THE FOLLOWING FIVE SUB SECTIONS

1.1 INTRODUCTION OF PIGMENTS

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2.2. CLASSIFICATION OF FLAVOURS

2.3. IMPORTANT COMPONENTS THAT CONTRIBUTE TO FLAVOR

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Let use see one by one,

1. Pigments:

1.1 Introduction

Pigments are used for coloring food, paint, ink, plastic, fabric, cosmetics and other materials. Most pigments used in manufacturing and the visual arts are dry colorants, usually ground into a fine powder. This powder is added to a vehicle (or binder), a relatively neutral or

colorless material that suspends the pigment and gives the paint its adhesion. The term “pigment” is used for coloring products such as food products, beverages, textiles, and pharmaceutical products. Pigments produce the colors that we observe at each step of our lives, because pigments are present in each one of the organisms in the world and plants are the principal producers. They are in leaves, fruits, vegetables, and flowers; also, they are present in animal skin, eyes, bacteria and fungi.

Pigments are chemical compounds that absorb light in the wavelength range of the visible region. Produced color is due to a molecule-specific structure (chromophore); this structure captures the energy and the excitation of an electron from an external orbital to a higher orbital is produced.

Pigments is added to food for one or more of the following many reasons;

(1) To replace color lost during processing,

(2) To that provide the red–purple shade of many fruits, in enhance color already present,

(3) To minimize batch- particular berries (e.g., strawberries, elderberries and to batch variations and

(4) To color foods or otherwise uncolored one are not attracted by buyers

1.2 Classification of PIGMENT

In today's world, there is a large number of Pigments available. In fact after the advent of Synthetic Pigments there has evolved various classes of pigments that are suited to particular types of Industries.

Pigments are mainly classified in to four categories

(i) Natural pigments

(ii) Synthetic or Organic pigments

(iii) Inorganic pigments

i**. Natural pigments** are produced by living organisms such as plants, animals, fungi, and microorganisms.

Moreover, natural pigments further classified by their structural characteristics as fallowing groups:

1. Tetrapyrrole derivatives: chlorophylls, hemes, and bilins

2. isoprenoid derivatives: carotenoids and iridoids

3. *N*-heterocyclic compounds different from tetrapyrroles: purines, pterins, flavins, phenazines, phenoxazines, and betalains

4. Benzopyran derivatives(oxygenated heterocyclic compounds): anthocyanins and flavonoids

5. Quinones: benzoquinone, naphthoquinone, anthraquinone. Melanins.

6. artefacts: melanoidins, caramels

For example, Hemoglobin is the blood pigment and also in cytochromes, peroxidases, catalases, and vitamin B12 as a prosthetic group, all of them with a wide distribution.

Plant porphyrins consist of chlorophylls also called as green pigments that are ubiquitous in nature since they are responsible for the photosynthetic process. In spite of their abundance, however, it is primarily plants such as alfalfa, nettle and leaves of carrot which are used as sources of these colorants.

The carotenoids are probably the best known of the food colorants and certainly they are one of the largest groups of pigments produced in nature. carotenoids lipid soluble compounds, responsible of the yellow & red colors of plants & animal products (430 – 480 nm). Most of produced carotenoids in nature is in form of fucoxanthin in various algae, in green leaves: lutein, violaxanthin, neoxanthin; β-carotene; lycopene in tomatoes; capxanthin in red peppers

Usually, a pigment is insoluble in the given medium, whereas a made by modification of materials from living organisms, dye is soluble. Thus, carotenoids are dyes in oil but such as caramel, vegetable carbon and Cu-chlorophyllin pigments in water. This distinction may be difficult to (vide infra), are also considered natural though they are in maintain if nothing is assumed about the medium and in fact (except for carbon) not found in nature.

ii. Organic Pigments are chemically synthesized, as they are not found in nature. They contain carbon and comes with relatively low levels of toxicity, not providing any major environmental concern. Raw materials can include coal tar and petroleum distillates that are transformed into insoluble precipitates. They are used as mass colorants and are popular in plastics, synthetic fibres and as surface coatings-

paints and inks Synthetic colors are man-made colors appearance is an important goal in the food industry.

Categories of Organic Pigments

Organic pigments are generally categorized into six types:

- Diazo Pigments
- Monoazo Pigments
- Acid and base dye Pigments
- Phthalocyanine Pigments
- Other polycyclic Pigments
- Quinacridone Pigments

Key features and characteristics of Organic Pigments

- Good tinctorial strength
- Cost effectiveness
- Consistency and unique shades
- Completely non-toxic
- Organic pigments shows good color strength
- Very good stability to solvents, light, heat, and weathering
- Very bright, pure, rich colors

iii. Inorganic pigments are created through chemical manufacturing rather than by grinding and washing clays or minerals taken directly from the earth. The preparation process is also simple and consists of the steps of washing drying, pulverizing and mixing into a

formulation. They are metallic oxides or synthetics. The following examples are very popular class of inorganic pigments.

TiO_2 (rutile), TiO_2 (Anatase), Antimony Oxide, Zinc Oxide, Calcium Carbonate, Fumed Silica.

Few other Examples of inorganic pigments: lead oxide, cobalt blue, chromium oxide, cadmium yellow, molybdate orange, and nickel titanate. As new environmental laws are very strict about toxicity a few of these heavy metal pigments are no longer in use.

1.3 Pigment extraction

Preparing samples from biological tissues is often tedious and time-consuming because the accuracy of the analysis depends on many parameters linked to the preparation of the sample. Examples are sample storage, process, etc. In addition, the complete extraction of pigments often requires several steps, and may use a mixture of several solvents. In rare cases, pigments can be extracted in a one step process.

1.4. Regulations to use the colorants

Strong regulations regulate the use of colorants and testing of toxicity on animals, usually rodents, have to be done before legalisation. Often it is necessary to find a level of Acceptable Daily Intake (ADI) to prevent the consumers of possible negative effects made by the supplements. FDA will be certify before entering into the market by toxicological testing such as subchronic feeding study and acute toxicity studies in at least two animal species (one with in utero exposure), lasting at least 24–30 months will be done before approve the pigments into the market.

1.5 THE HEALTH BENEFITS OF THESE PIGMENTS

Natural and synthetic pigments are used in medicines, foods, clothes, furniture, cosmetics, and in other products. However, natural pigments have important functions other than the imparted beauty, such as the following: we could not have photosynthesis or probably life all over the world without chlorophylls and carotenoids.

Chlorophylls Contributes to fighting harsh diseases**.** When chlorophyll is used together with lipids, the pro oxidant activity of these components has to be taken under consideration.

In animals how oxygen and carbon dioxide could be transported without hemoglobin or myoglobin. Under stress conditions plants show the synthesis of flavonoids; the quinones are very important in the conversion of light into chemical energy. The melanins act as a protective screen in humans and other vertebrates, and in some fungi melanins are essential for their vital cycle; last but not least, a lot of pigments have a well-known pharmacological activity in sickness such as cancer and cardiovascular diseases, and this has stressed pigment importance for human beings.

However, most of the pigments in nature work as natural antioxidants and the use of them as food supplements could make food products in the category “functional food”, which can positively influence on human health and give protection against some diseases caused by oxidative stress in the human body. In the food processing industry a lot of other colorants than is mentioned above, are used to make different kinds of colours in a huge assortment of products. Some of these colorants are: Turmeric, Caramel and inorganic and organic

miscellaneous colorants, but the main focus of this lecture will be on the main classes of natural pigments, their use as colorants, functional properties and potential health benefits of these components.

Golden rice is an example of a fortified food developed to be used in areas where there is shortage of dietary vitamin A. This rice is genetic engineered to produce β-carotene, a precursor of provitamin A in the editable part of the rice. The scientific details of the rice were published in *Science* in 2000. In 2005 a new variety of the rice was announced which were called *Golden rice 2*. This type is producing 23 times more β-carotene than the original variety of golden rice.

Uses

Over all, natural pigments used as food colorants are good colorants in a wide colour spectrum, and a source of healthy components in many food products. These healthy properties are mostly due antioxidant activity, and the opportunity to make functional food based on natural pigments is potential. Some natural pigments are already used in pharmacologic products, such as anti inflammatory etc., drugs based on water soluble carotenoids.

2. Flavors

2.1 Introduction

Flavor is the sensory impression of a food or other substance, and is determined mainly by the chemical senses of taste and smell. Flavorant is defined as a substance that gives another substance flavor, altering the characteristics of the solute, causing it to become sweet, sour, tangy, etc. Of the three chemical senses, smell is the main determinant of a food item's flavor. While there are only five universally recognized basic tastes - sweet, sour, bitter, salty, and umami (savory) - the number of food smells is unbounded. There are two main reasons uses flavors in food products, first, to add an intrinsic flavour - an example being flavoured mineral water with citrus extracts. Second use a flavor if it lost or modified during processing. Example: Fruit flavour in yogurt.

Historically there is little literature in the public domain on food flavours until the mid-1900s. At the beginning of the 1900s, a growing number of food and beverage companies including Kellogg, Campbell Soup, Coca-Cola and Pepsi-Cola, created even more demand for commercial flavors. Formalizing their association in the wake of the first Pure Food and Drugs Act of 1906, these early pioneers created the Flavoring Extract Manufacturers' Association (FEMA), the forerunner of today's Flavor and Extract Manufacturers Association. Today Indian share is about 10 % of the globe, which is Rs. 10,000 Crores.

2.2 Classification of flavors

There are three principal types of flavorings used in foods,

1. Natural flavoring substances which are extracted from vegetable or animal materials and are not further chemically modified or changed. An example is vanilla extract.

2. Nature-identical flavoring substances those are chemically identical to natural substances, but which are obtained by chemical processes or by chemical modification of other natural substances. An example is vanillin, which is identical to the vanillin in vanilla, but not obtained from vanilla pods.

3. Artificial flavoring substances: Substances obtained by chemical synthesis or chemical modification of natural substances, but which are not present in natural products.

Flavours also categorized on the basis of preparation

Flavouring preparation is a product from natural origin, but which is not highly purified. For example concentrated apple juice can be defined as a flavouring preparation.

Process flavourings are substances that are formed from natural substances upon processing, mainly heating. A common example is caramel, which is produced by heating sugars.

A smoke flavouring means a smoke extract used in traditional foodstuffs smoking processes. These are obtained by collecting the smoke into a fluid, which can be applied in a different production process.

Due to the high cost or unavailability of natural flavor extracts, most commercial flavorants are nature-identical, which means that they are

the chemical equivalent of natural flavors but chemically synthesized rather than being extracted from the source materials. It has been suggested that artificial flavors may be safer to consume than natural flavors due to the standards of purity and mixture consistency that are enforced either by the company or by law.

The list of known nature-identical flavoring agents are Diacetyl Buttery Isoamyl acetate, Banana Benzaldehyde, Bitter almond Cinnamic aldehydes, Cinnamon Ethyl propionate, Grape Fruity Methyl anthranilate, Limonene Orange Ethyl decadienoate, Pear Allyl hexanoate, Pineapple Ethyl maltol, Sugar, Cotton candy Ethylvanillin, Vanilla Methyl salicylate.

2.3 Important components that contribute to flavour: Taste & Colour. Certain colors are seen as corresponding to, and thus appropriate to certain odors (e.g., red for cherry odor). There is influence of color on odor identification, odor discrimination, odor intensity, and odor pleasantness. While salt and sugar can technically be considered flavorants that enhance salty and sweet tastes, usually only compounds that enhance umami, as well as other secondary flavors are considered and referred to as taste flavorants. Umami or "savory" flavorants, more commonly called taste or flavor enhancers, are largely based on amino acids and nucleotides. Umami flavorants recognized and approved by the European Union include: Glutamic acid, glycine salts, guanylic acid salts, inosinic acid salts, 5’-ribonucleotide salts.

Certain organic and inorganic acids can be used to enhance sour tastes, but like salt and sugar these are usually not considered and regulated as flavorants under law.

Acid Description Acetic acid Gives vinegar its sour taste and distinctive smell.

Ascorbic acid, better known as vitamin C, found in oranges and green peppers and gives a crisp, slightly sour taste..

Citric acid found in citrus fruits and gives them their sour taste.

Fumaric acid not found in fruits, used as a substitute for citric and tartaric acid.

Lactic acid found in various milk or fermented products and give them a rich tartness.

Malic acid found in apples and gives them their sour/tart taste.

Phosphoric acid used in all cola drinks to give an acid taste.

Tartaric acid found in grapes and wines and gives them a tart taste.

2.4 Flavour Manufacturing: Extraction

A simple process of obtaining flavouring substance from typical extraction process can be seen in coffee preparation. This process involves hot water separating the flavouring substances and flushing them out of the coffee powder. The filter then separates the soluble coffee components from the powder. The same principle of extraction is applied when deriving vanilla extract from vanilla beans. But here use alcohol or supercritical carbon dioxide (CO2) as solvents.

Extraction Techniques:

Liquid Carbon Dioxide Extraction- This technique also called as supercritical fluid extraction technique, the raw material is packed into stainless steel extraction columns and then dynamic flow of carbon

dioxide in liquid form, at pressures of 40-60 atmospheres in low temperatures between 0-10°C. In this condition, the liquefied CO_2 dissolves the lower molecular weight organic active components of the raw material and leaving behind the higher molecular weight unwanted materials such as heavier fats, waxes, pigments, sugars, starches and tannins. The solution of product in CO_2 emerging from the extraction columns is passed to a sophisticated heat exchanger. This leaves a pure extract of the product which is tapped from the process under pressure, still below ambient temperature.

Counter Current Extraction: Citrus oils in hydrocarbon solvent are continuously fed into a specially-designed column containing many compartments and this complex mixer, in which a counter-flow of ethanol containing a small amount of water, extracts the flavour and aroma molecules leaving the terpenes to emerge from the opposite end of the column.

Solvent Extraction Organic solvent extraction is the most common and most economically important technique. In this technique, the raw materials are submerged and agitated in a solvent that can dissolve the desired aromatic compounds. Most commonly used solvents for solvent extraction include hexane and dimethyl ether. During solvent extraction, aromatic compounds as well as other hydrophobic soluble substances such as wax and pigments are also obtained. The extract is then subjected to vacuum processing, which removes the solvent for re-use (or) the solvent is then removed by a lower temperature distillation process and reclaimed for re-use.

DISTILLATION PROCESS The technique is based on the fact that many substances have different boiling points. During distillation, liquid mixtures are separated by heating and the distillation process sees the plant or animal source material being brought to a certain, pre-determined boiling point. The steam is collected by cooling. In flavouring production generally in industries it is used to produce natural citral from lemon grass oil.

For example i. Vacuum Distillation is one of the simple techniques for concentration of essential oils before molecular distillation. The raw material or crude oil is heated under vacuum at precisely controlled temperatures, turning the components into vapour, which is then cooled and condensed to a purified liquid product.

ii. Molecular distillation: This distillation technique employs the material to heat for the briefest possible time, while at the same time allowing a very high vacuum to be achieved, which lowers the vaporizing temperature, contributing further to the limited exposure to heat. It allows a continuous feed of liquid to enter and pass down the inside of a heated jacket, wiped into a thin film by the centrifugal force of rotating rollers and falling by gravity.

iii. Alcohol Co-Distillation- It involves the addition of pure alcohol to the raw material which are first treated with water, followed by atmospheric pressure or low-vacuum distillation of the alcohol and some water which co-distils the more volatile components to yield a high aroma product. The advantages associated with these type of natural products are clean label, 100% Natural, enhanced functionality, product differentiation and true to nature.

iv. Steam distillation. Steam distillation is used as a general term to such products which requires roasting for flavor generation. The method includes, wetting the material with moist gas, steaming at varying pressure & Adding hot water. Generally, used in industries for obtaining coffee flavor.

2.5 Conclusion

Pigments and flavors components are important to a food appearance and taste. Both components can be e classified in to two categories Natural and Synthetic. Natural pigments and flavors can extracted from plant and animal source as as well as synthetic pigments and flavors can synthesize in laboratory. Synthesized pigments and flavors are more safe than natural because of high purity. Natural components may have unwanted side products and it could be toxic on human cells.

Thank you