



**Centurion**  
**UNIVERSITY**

# FOOD COLOURS THE NATURAL WAY



# INTRODUCTION

- Today's consumers are proactively seeking food products that contain '**safe**' ingredients in them.
- Colour is one of those important ingredients upon which the quality of food and flavour can be judged.

(Altinoz and Toptan 2003)

- These food colours are any substance that is added to food or drink to change its colour for acceptability.

(Kamatar

2015)

- These are derived from both artificial and natural sources in varied intensities.

Cont.....

- Artificial colours when added to food products possesses very bright and tempting effect, but very often are responsible for specific teratogenic and carcinogenic affects.
- Potential sources of artificial food colours are mineral compounds, petrochemicals, petroleum, and coal tar which leads to many harmful diseases like Attention Deficit Hyperactivity Disorder (ADHD), brain tumours etc.
- Thus, the natural colour market is currently going twice as fast as that of artificial colours.
- It has been observed that within last 10–15 years, there has been a distinct move towards naturals, especially within flavours and colours.
- Natural food colours not only give an appealing and appetizing look but also possesses varied nutritional and health benefits.

# WHY FOOD COLOURS

- - **To maintain or improve safety and freshness**
  - **To maintain or improve nutritional value**
  - **To improve taste, texture and appearance of the product**
  - **To influence the consumer to buy a product through visual perception**



# HISTORY OF FOOD COLOURS

**Around 1200 BC** (Bronze age),

Cleopatra and others added saffron in butter as first colourant to put a rich yellow colour.



**Around 1500 BC**, candy makers in

Egyptian cities added natural extracts and wine to improve the products appearance.



**In 1856**, William Henry Perkin

discovered the first artificial organic dye, called “**mauve**” by oxidizing aniline while trying to form an anti-malaria drug (quinine).



**By 1900**, many foods and drugs in U.S. were artificially coloured with many blatantly poisonous materials such as lead, arsenic, and mercury to hide inferior or defective foods.

**In 1906**, Congress passed the Food and Drugs Act, which prohibited the use of poisonous or deleterious colours in food industries.

**In 1962** The first EU directive, focussing on the use of colorants in foods was published. 36 colours (20 natural and 16 artificial) were considered safe for human consumption.

**In 2009**, Barry Callebaut's IBC brand specialized in colour and printing technology in food applications has launched **Power Flowers** by tempering cocoa butter and 40% coloring agents.



# CATEGORIES OF FOOD COLOURS

**Natural colours:** Pigments made by living organisms.

Examples: Beetroot extract, luetin, annatto.

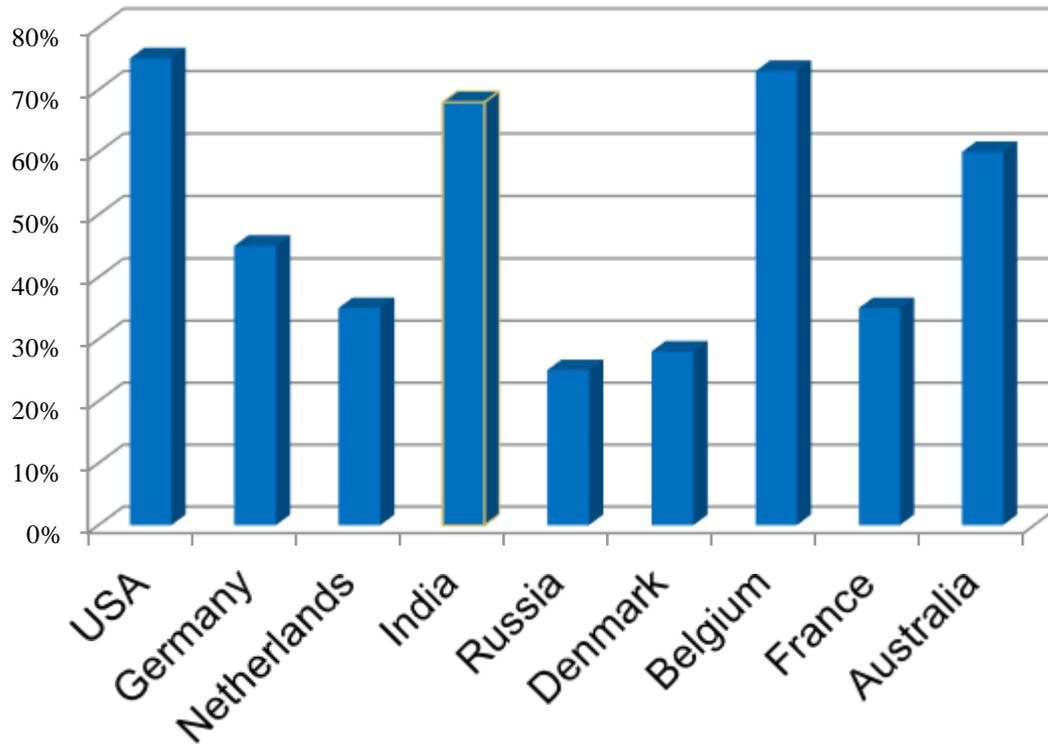
**Nature-identical colours:** Man-made pigments which are also found in nature.

Example: Betacarotene and canthaxanthin.

**Artificial colours:** Artificial colours are purely man-made colours.

Example: Alura red, Brilliant blue etc.

# GLOBAL MARKET TREND IN USE OF FOOD COLOURS



## Used in

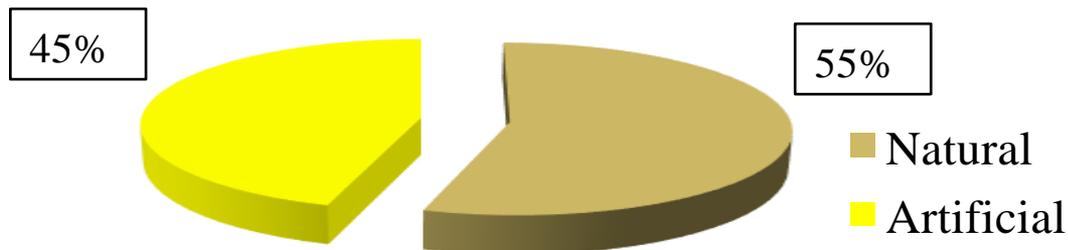
Sweets, Bakery, Confectionarie ice-cream, Fresh fruits and vegetables, Wine and otherss

Naidu and Soubhagya (2014), Technological advances in food

# USE OF NATURAL AND ARTIFICIAL COLOURS IN FOOD INDUSTRIES

Within the last 10-15 years, there has been a **distinct shift towards use of natural colours** than that of artificial colours in global market.

([www.futuremarketinsights.com](http://www.futuremarketinsights.com))



The global natural food colour market represented **54.9%** of the total food colour market in **2015** and is expected to account for nearly **60%** of the overall market by **2020**.

<http://www.marketsandmarkets.com/PressReleases/food-colors.asp>

# NATURAL COLOURS ARE BEST OVER ARTIFICIAL COLOURS

## REASONS:

Artificial food colourings causes:

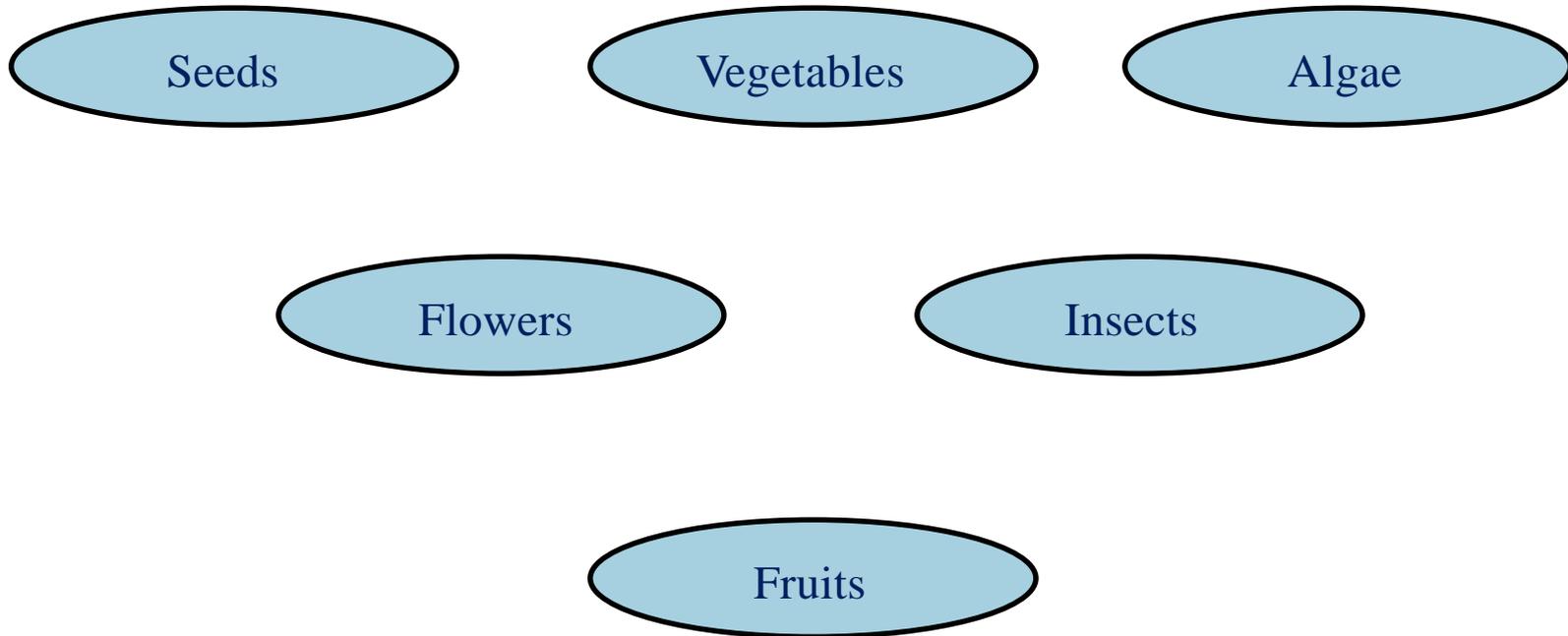
- Attention Deficit Hyperactivity Disorder (ADHD)
- Behavioural problems
- Depression
- Food allergies
- Headaches and migraines

### Case study

A recent study conducted by researchers at University of North Carolina(2015) found that more than 80 percent of child-oriented candies, cakes, fruit-flavoured snacks, drink mixes and powders are artificially coloured with **Brilliant Blue**, which in excess consumption lead to **Attention deficit hyperactivity disorder or ADHD**.

# NATURAL FOOD COLOURS

A natural food colour ( Biocolour) is any dye or pigment which when added to food products enhances therapeutic and medicinal properties in it. These are obtained from:



# AVAILABILITY

Food colours are available as

□ Liquids



□ Liquid gel dye



□ Powders



□ Gels



□ Pastes



# Types and uses of natural colours

Natural colourants	colour	Uses
Carmine	Bluish red	Soft drinks ,sugar & flavor confectionary ,pickles ,sousages
Sandal wood	Orange-orange red	Fish processing ,alcoholic drinks ,sea food dressings , meat product
Chlorophyll	Olive green	Soups, fruit products, jams
Beet powder	Bluish red	Frozen ice creams flavored milk
Turmeric	Bright yellow	Yogurt ,frozen products ,pickles
Riboflavin	Yellow	Cereal products ,sherbet ,ice cream
Safflower	yellow	Soft drinks ,alcoholic drinks

# Types and uses of natural colours

Natural colourants	colour	Uses
Anthocyanin	Blue-reddish shades	Soft drinks ,alcoholic drinks ,pickles
Annatto	Orange shades	Dairy & fat products and desserts
Beta-carotene	Yellow-orange	Butter ,fats ,oils ,soft drinks ,fruit juices ,ice Creams
Canthoxanthin	Orange red-red	Soups ,meat & fish dishes
Paprika	Orange-red	Meat products ,snack soups ,salad
Saffron	yellow	Baked goods ,rice dishes meat dishes ,soups
Leutin	yellow	ice creams ,dairy products ,sugar ,flour

# Permitted Natural Colours

In India, Rule 26 of The Prevention of Food Adulteration Act, 1954 (PFA) and The Prevention of Food Adulteration Rules, 1955 & 1999 permitted following colours which are isolated from natural sources

- ❑ Beet root concentrates
- ❑ Annatto
- ❑ Beta-carotene
- ❑ Cochineal Extract
- ❑ Grape extract
- ❑ Paprika oleoresin
- ❑ Turmeric Oleoresin
- ❑ Luetin
- ❑ Phycocyanin
- ❑ Saffron



# BEET ROOT CONCENTRATES

Beet contains inorganic nitrates which are precursor to a very important signalling molecule that our body needs to function- Nitric Oxide. NO acts as a vasodilator to allow more oxygen flow in Cardiovascular diseases (Disly. 2001)

**Source:** Red beet roots (*Beta vulgaris*)

**Colour:** Red, yellow & bluish red

**Colour pigment:** Betalains

**Applications:**

- Ice Cream
- Ice bar
- Hard candy
- Jam and jellies
- Sherbets
- Noodle/pasta



## Nutritional benefits of betalain

- Detoxifies body
- Fat free and energy giving
- Lowers cholesterol and BP
- Prevents skin ageing
- Excellent food during pregnancy, contains natural folic acid

Studies have shown that betalains have antioxidant, antimicrobial and antiviral activity (Pedreno and Escribano, 2001).

### Extraction:

**200 g of red beet mixed with 1liter of ethanol in a blender**



**Acidified with 2% citric acid for 15 min at room temperature**



**Left for 24 hours**



**Filtered and concentrated under vacuum by a rotary vacuum evaporator at 40°C**

# ANNATTO

Strong pigmentation of annatto seeds makes it a natural food colour and it has plenty of applications in cosmetics, but more importantly, it has numerous medicinal and herbal benefits

## **Annatto extract:**

- Extracted from annatto seeds, *Bixa orellna* L.

## **History:**

- Originated in Brazil
- Formerly used for body painting to ward off evil and also as an insect repellent.

## **Two forms:**

### **Bixin & Norbixin**



## **Bixin**

**Colour in final foods: Orange**

**Application:** Snacks  
Cake  
Butter  
Popcorn oil.



## **Norbixin**

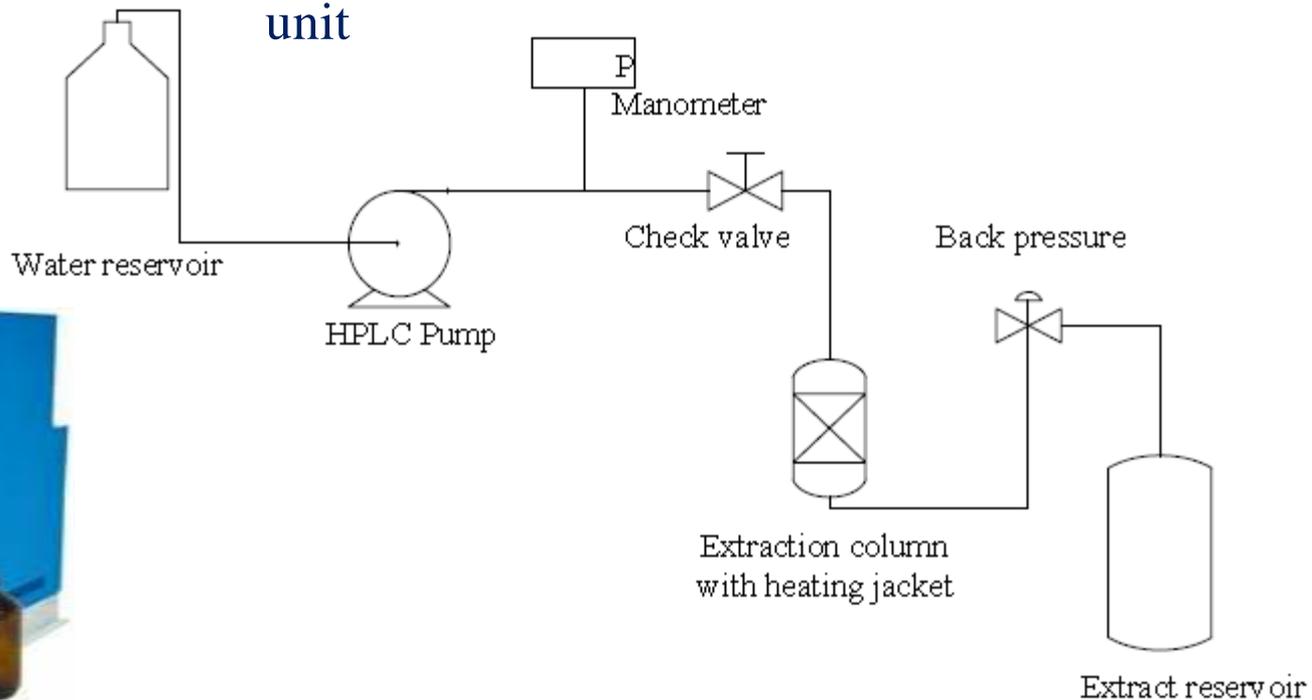
**Application:** Cheese (cheddar)  
Flavoured milk and drinks  
Snacks  
Bakery & confectionery.

## Nutritional benefits of annatto

- Improves memory
- Excellent wound healer
- Improves immunity
- Prevents constipation

### Extraction:

#### Pressurized water extraction unit



# BETA CAROTENE

Beta carotene is an organic, strongly coloured red-orange pigment abundant in plants and fruits.

**Source:** Carrot (*Daucus carota*)

**Colour:** Orange and yellow

**Colour pigment:** Carotinoids

**Applications:**

- Margarine

## Nutritional benefits of Beta carotene

- Act as Provitamin A
- Prevents from UV rays and sunburns
- Act as antioxidant and radical scavenger
- Prevents skin ageing
- It prevents from lung and breast tumour



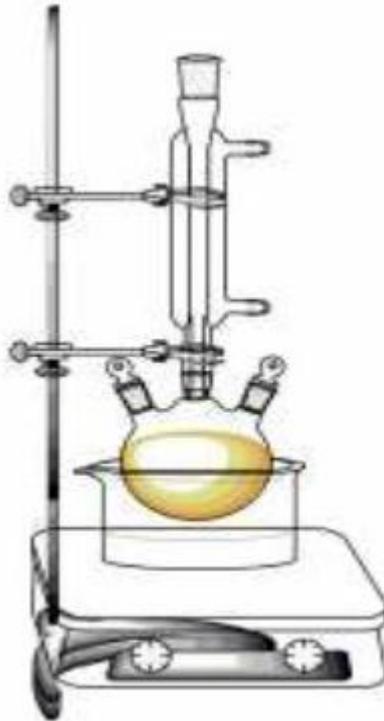
Studies have shown that Feeding carotene extracts prevents carcinoma formation in a two-stage model of skin carcinogenesis in male Sencar mice. (Punnamperuma. 2000).

## **EXTRACTION:**

### **Traditional boiling in ethanol:**

By boiling precipitate in a solvent for one or several sessions till the sought substance will be extracted which is finally Filtered.

### **Reflux boiling:**



# COCHINEAL EXTRACT

The cochineal is a scale insect from which the natural colour carmine is derived. It does not contain much nutritional aspects rather it is sometimes responsible for some allergic reactions.

**Source:** Cochineal insect

**Colour:** Magenta-red

**Colour pigment:** carmine or carminic acid

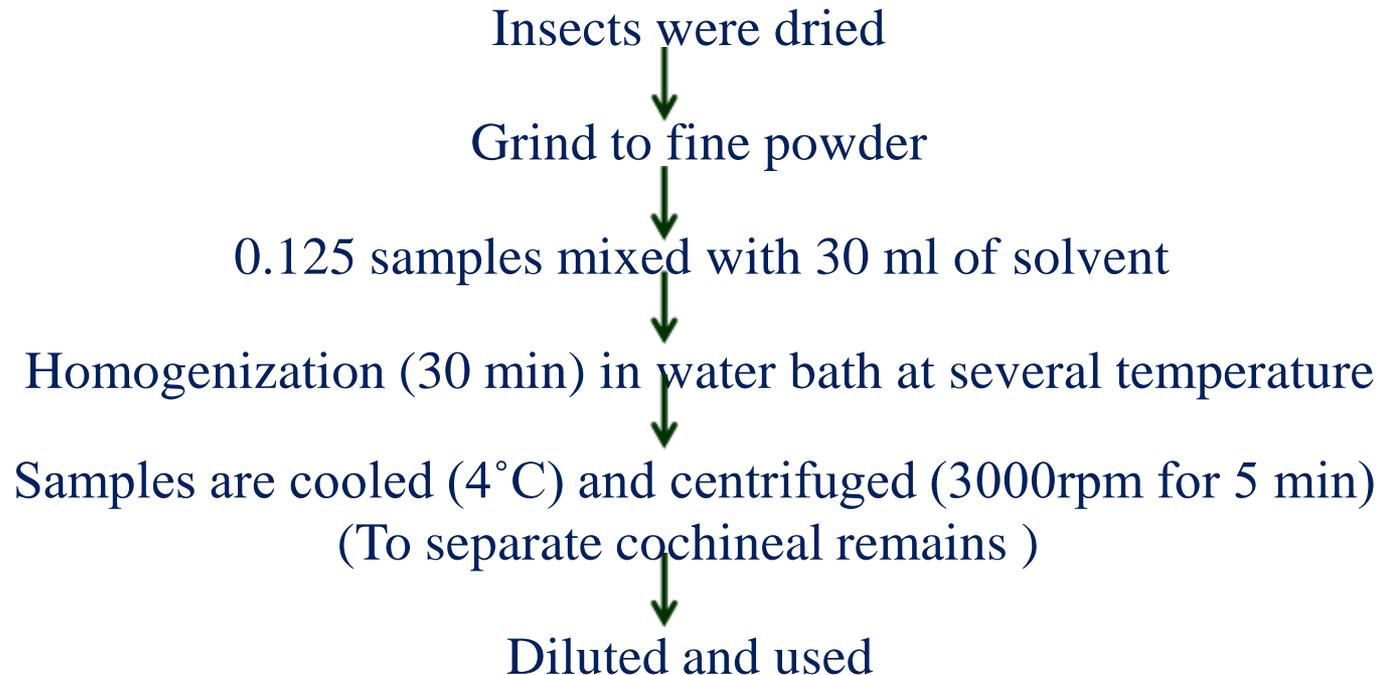
**Applications:**

- Cakes
- Alcoholic drinks
- Beverages
- Ice cream
- Candy
- Sweets.



Recent studies shows that carmine posses 500 times stronger vitamin E, antioxidant content and health-enhancing properties than that of some animal species such as astaxanthin found in salmon. (Adams 2014)

## **EXTRACTION**Conventional solid-liquid extraction



# LUETIN

Lutein in marigold along with zeaxanthin are potential antioxidants deposited in the retina of eyes and prevent macular degeneration

**Source:** Marigold flower (*Tagetes erecta*)

**Colour:** Light yellow to intensely yellow color

**Colour pigment:** Lutein

**Applications:**

Baked goods

Breakfast cereals

Dairy product

Fats and oils

Beverages

Chewing gums

Egg products

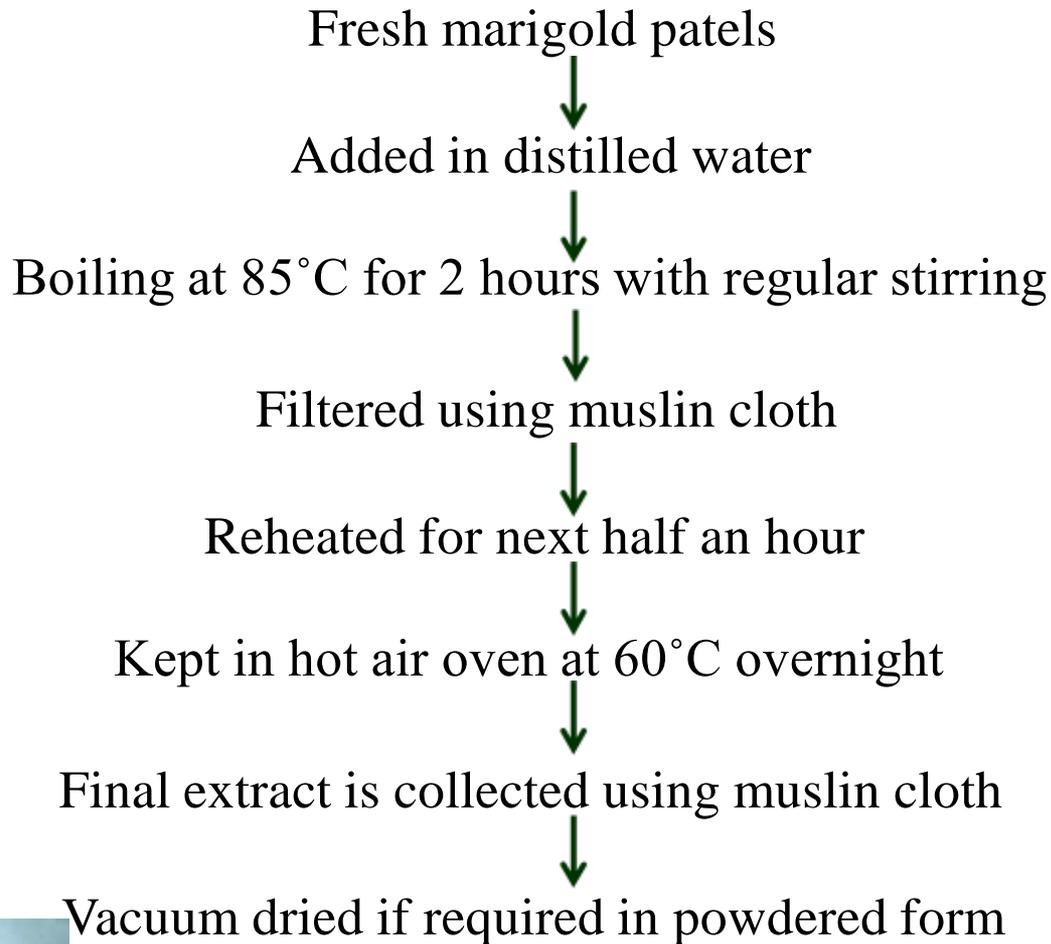
Sauces



## Nutritional benefits of Lutein

- Antioxidants in marigolds help fight and prevent cancer
- Boosts immunity
- Improves ocular health
- Excellent wound healer by rubbing on burns or scratches

## EXTRACTION:



# GRAPE EXTRACT

Anthocyanins and flavonols are the most important grape polyphenols as they possess many biological activities, such as antioxidant cardioprotective, anticancer, anti-inflammation, antiaging and antimicrobial properties (Xia *et al* 2010)

**Source:**

Cherry, raspberry, strawberry

**Colour:**

Blue purple

**Colour pigment:**

Anthocyanins

**Applications:**

- Fruit filling pie
- Gelatin desserts
- Jam, jelly and squashes
- Ice cream
- Candy
- Sweets.



## Nutritional benefits of Anthocyanins

- Anti-inflammatory and Anti-allergic
- Antibacterial
- Antiviral
- Anti-carcinogenic
- Vasodilator actions
- Visual acuity

A study was conducted on six types of berries(wild blueberry, bilberry, cranberry, elderberry, raspberry seeds, and strawberry) and found that presence of anthcyanins possess antioxidant efficacy, anticytotoxic potential, cellular uptake and anti-angiogenic properties.

# EXTRACTION OF ANTHOCYANIN

- Acidified ethanol extraction
- Aqueous two-phase extraction combined with column chromatography



## PAPRIKA OLEORESIN

Its active pigments accounts for 30–60% of total carotenoids in fully ripe fruits which comprises of 11 conjugated double bonds, keto group, and a cyclopentane ring. These structural characteristics give rise to free radical scavenging ability and prevent colon carcinogenesis. They also have stronger antioxidative effects than carotene. (Derera. 2005)

**Source:** Red pepper (*Capsicum annuum*)

**Colour:** Bright orange to red-orange in food products

**Colour pigment:** Capsanthin and Capsorubin

**Applications:**

- Seasonings
- Snacks
- Salad dressings
- Popcorn
- Beverages

## Nutritional benefits of Capsanthin

- ❑ Anti-inflammatory and Antioxidant properties
- ❑ Natural sources of omega3 fatty acid
- ❑ Fight against gastritis and acidity
- ❑ Decreases motion sickness and nausea
- ❑ Rich source of Vit C
- ❑ Relaxes respiratory muscles

Recent evidence reveals that Capsanthin present in red pepper contains beta-carotene, a precursor of vit A. These Vit A plays a crucial role in the maintenance of healthy skin and prevents prevalence of wrinkles.

# EXTRACTION OF PAPRIKA

- Supercritical carbon dioxide filtration
- Vacuum filtration
- Soxlet extraction



## TURMERIC OLEORESIN (CURCUMIN)

Turmeric (*Curcuma longa*) has been used for 4,000 years to treat a variety of conditions. Studies show that turmeric may help fight infections and some cancers, reduce inflammation, and treat digestive problems (Krishnaswamy 2008)

**Source:** Turmeric (*Curcuma longa* L.)

**Colour:** Yellow orange

**Colour pigment:** Curcumin and curcuminoids

**Applications:**

Preserved foods like pickle

Baked foods

Confectionary



# Nutritional benefits of Curcumin



# PHYCOCYANIN

Among all microalgae, genus *Spirulina* are the most inexpensive source of pigment- phycocyanin. It has many commercial applications like in food as colourants, cosmetics and in biomedical research. It is also a potential pharmaceutical in oxidative stress-induced diseases as it has antioxidant and anti-inflammatory properties. (Deng, 2010)

**Source:** Blue green algae or Spirulina

**Colour:** Light greenish blue to intensely dark blue colour

**Colour pigment:** Phycocyanin and Cyanobacteria

## Applications:

**Dairy industry:** Ice cream, Yogurt, Frozen Desserts, Cheese.

**Beverages Industry:** fruit drinks, Soup Mix.

**Confectionery:** Coated soft candy.

**Bakery:** Baked Goods, Baking Mix.



# Spirulina Health Benefits



1. Anti-Inflammatory
2. Boosts the Immune System
3. Great Source of Nutrients
4. Helpful in Allergies
5. Anti-Cancer
6. Purify the Liver
7. Remove Toxin from the Blood
8. Useful for Radioactive Exposure

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In recent studies, researchers has observed that the usual increase of systolic blood pressure in stroke-prone rats was suppressed by Phycocyanin treatment.

# EXTRACTION OF PHYCOCYANIN

- ✓ Inorganic acid extraction
- ✓ Hexane extraction process combined with high pressure

Seo *et al.*, (2013)  
[Http://www.ncbi.nlm.nih.gov/pmc/articles/PMC356534](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC356534)

# SAFFRON

The high antioxidant activity of safranal compound in saffron possesses bioactive properties and free radicals scavenging ability at cellular level, thereby alleviating various metabolic syndromes.

**Source:** *Crocus sativus* flower (saffron crocus)

**Colour:** Golden yellow

**Flavour forming compound:** Picrocrocin, and Safranal.

## Applications:

- As seasonings
- Desserts
- Sweets
- Health drinks
- Traditional food items



## NUTRITIONAL BENEFITS OF SAFFRON

1. Treats Depression

2. Prevents Cancer

3. Boosts Memory

4. Helps with PMS

5. Relieves toothache



6. Prevents vision loss

7. Insomnia

8. Soothes Fever

9. Helps in Arthritis

10. Skin Health

Studies shows that saffron have the potential of reducing blood pressure and mood swings along with preventing morning sickness during pregnancy

# EXTRACTION OF SAFFRON

- ✓ Ultrasound assisted extraction (UAE)
- ✓ Rapid solid-liquid dynamic extraction (RSDE)

Seo *et al.*, (2013)  
[Http://www.ncbi.nlm.nih.gov/pmc/articles/PMC356534](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC356534)

# INDIAN COMPANIES THAT PRODUCE NATURAL COLOURS

Anju Phytochemicals private limited ; Bangaluru

India

International flavours an Fragnances ; Chennai

India

L Liladhar and company ; Navi mumbai India

SAF East company private company ; Mumbai

India

Snowfield Plante naturelle ; Thane India

Vin Flavours ; Vadodara India

# **FUTURE PROSPECTS OF NATURAL FOOD COLOURS**

## **Microencapsulation:**

Increased light stability will be achieved with encapsulation of some sensitive colours (annatto and paprika)

## **Addition of antioxidants:**

To increase nutritional value of some food colours, external antioxidants ( like tocopherols, ascorbic acid and rosemary extract) can be fortified.

## **Emulsions:**

By formulating an easy to disperse colour emulsion to remain stable in many different food applications ( gums or modified starches)

## **Development of new sources:**

Extensive research should be done in introducing new colouring agents in the market.

Moshfeghi et al,. (2013) recently introduced Dragon Fruit Coloring Powder (DFCP) as a natural food additive in Malaysian market which is rich in vitamin C and minerals (potassium, sodium, calcium, iron, and phosphorus)

## LIMITATIONS OF USING NATURAL FOOD COLOUR

Some sources of natural colours have their own flavour which may affect the taste of the finished product. (Turmeric)

Actual colour may not retain as such when subjected to high temperatures. (Grape juice extract)

Can cause allergic reactions (Cochineal extract, Annatto)

Natural food colour are costlier than artificial colourings (Saffron)

At times raw ingredients remains scarce. (Marigold extract)

Require in large quantities when compared to Artificial dyes. (Cochineal extract)

*Thank You*