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NATURAL FOOD COLOURS FOR INDUSTRIAL OPPORTUNITIES AND DEVELOPMENT.

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ABSTRACT

A study of the opportunities of natural food colours for industrial development was carried out to establish the availability of natural raw materials for processing, the processing techniques, industrial uses in the food and pharmaceutical sectors, and create awareness of the use and establish the economic importance of local processing of food colours from natural sources. Sources of natural colours were found to be widely available in Nigeria. Tubers, seeds, calyxes/flowers pressed fibres and rhizomes of various plants were found to be ready. 59 questionnaires were administered of the 35 that responded covering the food, beverage and pharmaceutical industries. Almost all companies presently use synthetic colourants exclusively; but were willing to use natural colourants provided they meet acceptable standards for food use. The total quantity of food colours imported yearly from 1990 to 1994 range from 13,127,112kg to 38,898,852kg with a corresponding value of N261,979,007 to N1,035,863,115 annually.

INTRODUCTION

Food colours are food additives used to enhance the looks and appeal of food. It is generally accepted that colour is one of the most important attributes of food, since appearance is the first sensory measurement of a food's quality and appeal.

Food colours add value to food by improving the appearance of such foods. The food industry is a rapidly growing one and with industrialisation comes the need for new food stuff much of which will be "Mass Produced" leaving the product greatly devoid of an acceptable appearance, which in turn affects its acceptance.

Food colouring in commercially minded times can be introduced into food to mask deficiencies and spoilage in foods such as butter, egg, chocolate and fruits (1). Other reasons for colouring foods are to ensure uniformity in colour of product where raw materials have been gathered from different sources and of varying hues and intensity; to restore appearance of foods that have lost their natural colour in the course of processing; to reduce cost and improve quality to the manufacturers' benefits (2). A secondary reason for colouring foods is as a fortifier in foods as in carotenoids which are precursors of the A vitamins and are helpful in maintaining good sight (3).

The colour of food can enhance the enjoyment of the food, quality of life and food choices. The colour of food can even suggest flavour of the food. There has been a direct link between the colour and the flavour appreciation of foods. Foods coloured bright orange are perceived as being sweet while those coloured light greenish are perceived as being sour (1).

The practice of colouring foods has gone through quite a revolution, starting with the early times when the only available colouring matter were of natural sources; then came the use of synthetic and nature identical food colours. Now, however, the trend is reverting back to natural colours because of the attendant health problems encountered with the use of synthetic colourants. It is against this backdrop that the Federal Institute of Industrial Research, Oshodi started research work on food colours from natural sources. Edible, local and safe plant sources are investigated for their colourant properties.

At present in Nigeria many food and pharmaceutical industries still depend largely or solely on synthetic colourants for their productions. With the global trend of turning to natural colours it becomes necessary for a change in the Nigeria food and pharmaceutical industries where that change is possible.

This paper deals with identifying industries who require for their use, already use or perhaps should use but are presently not using natural colourants in their production. It identifies some natural colourant sources, processing methods and the relevance of such natural colourants to the industries.

MATERIALS AND METHODS

Availability of natural sources of food colour in Nigeria

The sources of natural colourants and their availability in Nigeria were obtained from literature and publications of the Federal Offices of Statistics, Central Bank of Nigeria, Federal Ministries of Agriculture and National Planning. Additional information were obtained from the research work of the Chemical Technology section of Federal Institute of Industrial Research, Oshodi.

Use of natural food colours by industries

The use of natural food colours to industries in Nigeria were determined by questionnaire designed by the Technology Marketing Division of the Federal Institute of Industrial Research Oshodi, and administered to companies located within the Lagos environs personally through interviews.

Questionnaire addressed to companies located outside Lagos were sent by mail. 59 companies in all were targeted as current and potential users of natural food colourants.

The companies were from the dairy, confectionery, bakery, fats and fatty foods, fruits and vegetables, fish farming, poultry feed, Beverages, cosmetics and pharmaceutical sectors of the economy.

A survey of processing methods for the production of natural colourants from edible and safe plant sources were compiled from

the research findings of the Chemical Technology section of the Federal Institute of Industrial Research Oshodi Nigeria where various plant materials are being screened for use as natural colourant and simple easy to operate methods of productions of the colourants are developed.

a) Solvent extraction

This method of extraction is suitable for most organic natural colourants that are not water based such as paprika and curcumin. Solvents employed in this method include hexane, acetone, methanol, ethanol, dichloromethane. 10g of dried plant materials were placed in the Soxhlet extractor and extracted using suitable organic solvents for specific time intervals. After complete extraction, the extracts were concentrated using a vacuum rotary evaporator at temperature of 30°C.

Residual solvents were removed by placing extracts in an air oven at 40°C for 8 – 10 hr. Extracts were purified before packaging and storage by column chromatography. Adsorbents for packing the columns were chosen based on the specific nature of the extracts.

b) Soaking and Maceration

This method is useful for extracting water based colours such as anthocyanins. 50g of plant material was macerated and soaked in methanol or ethanol containing a small amount of mineral acids. When sufficient colour has been extracted, the acidified, alcoholic solution was concentrated by removal of solvent in a rotary evaporator at low temperature of about 30°C to prevent degradation and hydrolysis of the colourant.

The concentrate was then purified by column or paper chromatography. The extract concentrate can be used as such or preserved by storing at – 20°C or by turning it into a powder through the freeze drying process and kept in hermetically sealed containers. The powder from this process is often hygroscopic.

Spray-drying of the concentrate using a carbohydrate carrier was also done. The carbohydrate carrier made up about 30% of total solids to give an acceptable powder.

c) Maceration and pressing followed by solvent extraction.

This method of extraction is suitable for the chlorophyll type colourants.

2g of the vegetable material was placed in a glass mortar containing purified and washed sand. Calcium carbonate was added to the mixture and the whole ground to fine fibre. The colourant was extracted from the finely ground fibre using 85% acetone solution, and the solution filtered using a vacuum pump.

The residue is transferred back to the mortar and the process repeated till the colour has been completely removed. The filtrates were combined and concentrated by removal of solvent. Crude chlorophyll extracts were purified in diethyl ether – petroleum ether under carefully controlled conditions. Further processing by solvent extraction of the crude extract yielded commercial grade colourants.

RESULTS AND DISCUSSION

The result of the survey showed that sources of natural colourants abound within the country Nigeria. A listing of some sources of natural colourants, their distribution within the country and the class of compounds to which these colourants belong is given (Table 1).

Nigeria is traditionally an agricultural country with all the states of the federation being endowed with many varieties of agricultural produce. The varying vegetation and climatic pattern across the country from its Northern borders with Niger and Chad to its Coastal borders in the Atlantic ocean give Nigeria enormous potentials for agricultural resources. This means that raw material for the production of natural food colourants are readily available with a wide variety all across the country. The sources of

colourants range from tree barks to roots, tubers, vegetables, leaves, flowers, fruits and seeds.

The analysis of questionnaires on the use of food colourants by the industries is presented (Table II). Analysis of the questionnaires showed that practically all colourants in use by the industries that responded are synthetic. The use of natural colourants was limited to caramel.

The synthetic colourants in use by these industries are majority imported.

Table III gives the data on importation of food colours into Nigeria from 1990 to 1994.

Table 1. Sources and distribution of natural food colourants in Nigeria.

Plant	Part of Plant used	Colour	Distribution
Annatto	Seeds	Orange/Yellow	Across the country
Beetroot	Root	Red	Northern Parts
Roselle	Calyces	Red	North/middle belt
Black plum	Fruits	Red	Across the country
Palm fruits	Fruits	Yellow	Southern Parts
Tumeric	Rhizome	Yellow	Northern Parts
Cocoa	Seeds	Brown	Western Parts
Garden Egg	Leaves	Green	Across the country
Carrot	Root	Orange/Yellow	Northern Part
Orange	Peel	Orange/Yellow	Southern Part
Paprika	Fruit	Red	Across the country
Purple corn	Grains	Red	Northern Parts
Miracle fruit		Orange/Yellow	Southern Parts
Grape	Skin	Red	Northern Parts
Cherry plum	Leaves	Red	Across the country

It was found that total quantity of food colours imported yearly range from between 13, 127, 112,kg to 38, 898, 852kg with a corresponding value of N261,979,007 to N1,035,863,155 annually.

Table II. Analysis of questionnaires on use of food colourants by industries.

Type of Industry	Products.	Colourant Usage S N None	Sourcing	Quantity used/ annum	Estimated Cost annually =N=	Willingness to use NFC if available
Food	Milk & Dairy Product	✓	--	--	--	--
Pharm	Tablets, Syrups, Baby care medicines	✓	Imported	200kg	--	Yes must meet WHO standards must meet in house specification
Pharm	Tablets, syrups, capsules	✓	Imported	--	--	Yes
Food	Biscuits	✓	Local	--	--	Yes
Food	Food drinks, confec-seasonings	✓	Imported /Local source	20,000 kg	20,000,000	Yes
Pharm	Blood Tonic, Capsules	✓	Local	--	--	Yes
Food	Biscuits	✓	--	--	--	

Pharm	Antibiotics, Capsules, Haema - tinics, Analgesics etc.	✓	Local/ Sourcing through importers	50kg	100,000	Yes
Pharm	Syrups, Tablets Capsules, Powders	✓	Imported	50kg	300,000	Yes

Source: Recent survey at FIRO 6

S: Sythentic N: Natural.

NFC: Natural Food Colours

From this it can be deduced that large quantities of food colours are being imported into the country and this expends more than one billion naira annually. This also implies that huge sums of money in foreign exchange is expended annually on importation of food colourants into the country.

Production of natural food colourants from available safe, edible plant sources locally will save much foreign exchange while improving the health of the nation.

From the survey of processing methods, there can be obvious opportunities for industrialisation both on cottage scale and simple inexpensive methods, to the more sophisticated hi-tech industries improving the economic life of a wider cross - section of the people of the country.

Three major methods of producing food colourants from local plant sources were found to be used in FIRO. These methods can be adapted to suit the peculiar needs of either the small cottage based Industries or the larger "hi-tech" Industries. Solvent extraction is used for fat soluble colours, maceration and pressing for water based colours (4). Maceration and Pressing is also used with solvents as extractants.

The chlorophyll type pigments are extracted by boiling followed by solvent extraction or maceration and manual grinding in the

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Table III. Importation of food colour into Nigeria.

Year	Category of Colour	Quantity (kg)	Value =N=	Total Value/ Annum (=N=)
1990	Natural Indigo Colour Lakes Other Synthetic Organic Colour	65,532 632,824 12,428,756	8,844,393 10,646,047 242,488,567	261,979,007
1991	Natural Indigo Colour Lakes Other Synthetic Organic Colour Luminophares	2,676,975 297,444 27,749,085 135,551	59,410,427 9,192,398 416,512,675 4,423,505	489,538,955
1993	Natural Indigo Colour Lakes Other Synthetic Organic Colour Luminophares	856,780 54,830 37,784,555 202,687	53,901,380 4,466,861 964,172,488 13,322,426	1,035,863,155
1994	Natural Indigo Colour Lakes Other Synthetic Organic Colour Luminophares	240,580,8 398,438 5,545,875 100,044	4,617,569 4,717,513 843,977,095 9,842,926	993,155,103

Source: Nigerian Trade Summary, Federal office of Statistics 7.

Presence of sand as abrasive followed also by extraction using appropriate solvents (5).

Research and development of varieties of colour yielding plants will thrive, and open up a large and novel area of exploration. From the data almost all Industries who responded were willing to

use natural colourants provided they are readily available, soluble in water and sugar syrup; show good fastness (Table II). On exposure to light, and be free from bacterial contamination.

CONCLUSION

From the analysis above, the implications of the use of synthetic colourants by local Industries is the impact on the health of the nation viz-aviz the economy. There is therefore a need for awareness creation on the use of natural food colourant in the industries and intensification of research in the area of adaptation of imported technology to suit local raw materials. The importance of enhancing the research and development on the use of locally sourced raw materials for production of food colours; especially in these days of dwindling foreign exchange and high import bills cannot be over emphasized. The growth of both the agricultural and Industrial sectors would be enhanced as well as raising the productivity in the economy. Also of immense benefit to the country would be the impact/influence of this development on the health of the nation.

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A.A. Okin
Depart

The alignment of the Calabar Flank interpreted as - 20km in length activity in the NE-SW and reflection of tectonic trend. Niger Delta basin basement tectonic major tectonic Flank.

Calabar flank is 8° 30'E). It is Benue Trough and it extends Calabar flank continental margin.
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