Studies on bio colour extraction from elephant foot yam

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ABSTRACT

Colour is an inherent property of foods and it enhances the delicacy of food not only provide flavor and delight appearance, but it also provides information on quality and condition of the food products. The synthetic colours are toxic and they have proved to be harmful to human health and also make it undesirable for human consumption. Consumer awareness and growing concern over the safety aspects of synthetic colours have put the pressure on food processors to adopt natural colours, which are considered to be safe to the consumer. Therefore the attention of food industry has turned to use synthetic colours in food products. Natural food colours are generally extracted from fruits, vegetables, seeds, roots and microorganisms. Natural food colours protect food from oxidation by enzymes. Therefore, they not only enhance the appearance and flavor to the food but also protect the food from oxidation. Many natural colorants are rich in nutrients and antioxidants and their presence in the diet reduces the risk to many diseases. The present study was conducted to extract the bio food colour powder from elephant foot yam by using spray dryer. The colour was extracted with water and acetone as a solvents, different level of maltodextrin (15, 20 & 25%), drying termperature (160, 180 and 200^{o}C) and flow rate (25 & 30 ml per min). The yield recovery 9.3g/100ml was maximum at 180^{o}C with a flow rate of 25 ml / min at 25 % maltodextrin. The colour value L* was found to be 181.05, a* - 9.33and b* was found to be 56.06. The powder was sensory evaluated and sensory score was recorded as 8.2 thus, natural colorants from foot yam which are rich in nutrients, antioxidants and their presence in the diet reduces the risk to many diseases.

Key words: Foot yam, spray drying, flavoured milk, maltodextrin, sensory score.

Colour is an inherent property of foods and it enhances the delicacy of food not only provide flavor and delight appearance, but it also provides information on quality and condition of the food products. Colour is one of the first characteristics perceived by the sense and is dispensable for rapid identification and ultimate acceptance of products (Parvathi and Subbulakshmi, 2016). Most manufactures use different synthetic colours in bakery products, soft drinks and various kinds of toffees, ice cream, jam, jellies etc. Even house wives use colours while preparing different dishes to give attractive and appetizing look to the foods. Many food industries use synthetic colours because during processing and storage, the natural colour of the foods get lost which necessitate to add synthetic colours to enhance (or) restore the original appearance to the processed food products (Roy *et al.,* 2004). The synthetic colours are toxic and they have proved to be harmful to human health and also make it undesirable for human consumption. Consumer awareness and growing concern over the safety aspects of synthetic colours have put the pressure on food processors to adopt natural colours, which are considered to be safe to the consumer (Eliana *et al.,* 2007). Therefore the attention of food industry has turned to use synthetic colours in food products. Natural food colours are generally extracted from fruits, vegetables, seeds, roots and microorganisms. Natural food colours protect food from oxidation by enzymes.

Therefore, they not only enhance the appearance and flavor to the food but also protect the food from oxidation. Many natural colorants are rich in nutrients and antioxidants and their presence in the diet reduces the risk to many diseases (Mazza, 2000 and Reddy *et al.,* 2005). Though the natural colours have lot of beneficial aspects but it has many disadvantages when compared to synthetic ones including high cost, poorer tint,

strength and lower stability. So, improving the stability of natural pigments by use of additives, alternation in physical forms colour preparation and some precautionary measures are suggested during application in processing and storage. However natural colours are harmless and healthy. Hence an effort was made to extract natural colours from elephant foot yam.

MATERIALS AND METHODS

Two kg of good quality elephant foot yam of pink variety was purchased from whole sale vegetable market at Madurai district, Tamil Nadu India. They were washed and peeled using still knife. After peeling, it was cut into cubes (4-5 mm). These cubes were soaked in one per cent citric acid for one hour to remove acridity in tubers. Then the cubes were washed with water and then blanched in a steamer for 5 min. Blanching helps to avoid browning in the finished products. The blanched cubes were ground with solvent (10 ml of acetone) and 250 ml of water by using a food processor (Preethi, blue leaf model) till it grind fully and it was filtered through muslin cloth. Gristina *et al.* (1998) reported the use of acetone for extraction with water mixture helps complete separation of liquid from the solid mass of the plant materials and subsequently produced a very clear liquid after filtration. Generally different solvents and acids were added for extraction of natural food colours. The most common solvent used is citric acid. Rosario *et al*. (2006) reported to isolate pigment from opyntia stricta, the solvent ethanol and water 60:40 ratio was used which reduced the viscosity caused by the presence of starch. To the extract maltodextrin was added till it reaches 25^{o} bx and again filtrated through muslin cloth and spray dried (LS8-48 min spray drier at the rate of 20 ml / min.

a. Standardization of drying, process for the production of natural food colour

To optimize the drying process for the production of natural colourants from the elephant food yam extracts, the process parameters such as addition of maltodextrin, inlet drying air temperature and feed rate for spray drying were selected. The range is given in Table 1.

Table 1. Optimization of drying process

Sl. No.	Parameters	Levels
1.	Maltodextrin	10, 20 and 25 per cent
2.	Drying temperature	160, 180 and 200^{o}C
3.	Feed rate	25 and 30 ml / min

Collection of tuber
↓
Washing
↓
Peeling
↓
Cutting into cubes (1 to 2 mm)
↓
Soaking in citric acid (1% citric acid for 2 h)
↓
Blanching (80^{o}C for 5 minutes)
↓
Grinding (Adding 10 ml acetone with 250 ml of water)
↓
Filtering (using muslin cloth)
↓
Adding maltodextrin (to reach TSS upto 25^{o} Brix in the extract)
↓
Filtering through muslin cloth
↓
spray drying
↓
Natural colour powder

Fig 1. Steps in extraction of bio colour from elephant foot yam

To identify the effective range of maltodextrin for extraction of colour, different levels of maltodextrin at 10, 20 and 25 per cent were added to the extracts and filtered using muslin cloth. The filtrate was fed in the spray drier with in an inlet drying air temperature (160, 180 and 200^{o}C) and the feed rate as 25 and 30 ml / min. Based on the trails, the process parameters, viz, inlet drying air temperature, feed rate and maltodextrin were optimized as 180^{o}C, 25 ml / min and 25 per cent respectively for extracting the

natural colour powder from elephant foot yam by using spray drier.

b. Determination of Physico-Chemical of spray dried powder

Moisture

The moisture content of spray dried elephant foot yam powder was estimated using the hot air oven (Narang Scientific Works, New Delhi, India) as described in AOAC (1995). Five gram of sample was accurately weighed and dried in an oven at 105^{o}C until constant weight was obtained. The moisture content was expressed in percentage.

pH

The pH of the sample was measured by the method described by Rekha *et al.* (2007) using pH meter (Analog model 301, Corian Research, USA).

Total Soluble Solids

Total Soluble Solids (TSS) was estimated by the method described by Saini *et al.* (2001).j by using hand refractometer (Erma, Japan).

Colour intensity (L* a* b*)

Colour measurements (L* a* b* values) of the spray dried sample were determined using a Hunter Laboratory chromometer (Mode # Lovibond RT 100) with the Lovibond RT colour software (Version 3.0). It works on the principle of collecting and measuring the energy from the samples reflected across the entire visible spectrum. Filters and the mathematical models are used, which rely on "Standard observer curves" that defines the quantity of red, green and blue primary lights required to match a series of colours across the visible spectrum. Before measuring the colour of the samples, the instrument was standardized by placing black and white standard plates. The sample colour was measured by filling the elephant foot yam powder in the transparent cup without any void space at the bottom. L* values corresponding to lightness / darkness and extend from 0 (black) to 100 (white) with higher values corresponding to more lightness. The a* and b* values corresponding to an object's colour dimensions, with a* values describing sample's red (+a) to greenness (-a), while b* values describe a sample's yellow (+b) to blueness (-b). Larger a* values indicate more redness and larger b* value indicate more yellowness. (Hathron *et al.,* 2006).

Water activity

Spray dried elephant foot yam powder was analyzed using water activity meter (Model-AQUALAB series 4 TE, Device Co., Germany) at 25^{o}C. It is a fundamental property of aqueous solutions, and by definition is the ratio of the vapor pressure of the water in the substrate (p) to that of pure water at the same temperature (p_0).

$$A_w = p / p_0$$

Sedimentation

The sedimentation rate of the sample was noted till a constant value was obtained by using the method described by Kalalingam, 2003.

β-carotene

The β-carotene content of the colour obtained from the selected tuber was estimated as suggested in AOAC (1995).

c. Sensory evaluation of foot yam powder

The spray dried powder was given to the 15 semi trained judges by using 9 point hedonic scale to assess the acceptability of the powder *viz.,* color, appearance, taste, flavor, texture and overall acceptability. The ratings were ranging from 9 as like extremely to 1 as dislike extremely as outlined by (Swaminathan, 1980).

RESULTS AND DISCUSSION

a. Standardization of drying process for the production of natural food colour from elephant foot yam

The natural colour recovery from the selected tuber was varied from 5.9 to 9.3 g / 100 ml of extract. Maximum powder recovery of 9.3 g/ 100 ml was observed at 180^{o}C drying air temperature, 25 ml / min feed rate and 25 per cent of maltodextrin, minimum powder recovery of 5.98 / 100 ml was obtained at temperature of 160^{o}C at feed rtes and maltodextrin level. At 200^{o}C all drying air temperature, the powder get charred at all feed rates and at different levels of maltodextrin. Hence the parameters such as inlet drying air temperature, feed

rate and maltodextrin were standardized as 180^{o}C, 25 ml / min and 25 per cent respectively.

b. Physico chemical properties of spray dried elephant food yam powder

Physico chemical properties of natural food colourant of elephant foot yam extracted using spray drying method are given in Table 2.

Table 2. physico – chemical properties of natural food colourant

Sl. No.	Parameters	Levels
1.	pH	4
2.	TSS^{o} Bx	35^{o}bx
3.	Water activity	0.38%
4.	Sedimentation	0.05
5.	β-carotene	304 µg

From the above Table 2. it was observed the moisture content and water activity of the spray dried powder were found to be 0.8% and 0.38 per cent. One of the characteristics of the spray dried products is the low moisture content it should be less than 5%. The moisture content of the tested sample is less than 5 per cent. Water activity (a_w) is a very important index for spray dried powder as it determines the shelf life of the produce. Water activity measures the activity of free water in a food system, which is responsible by any biochemical reactions and thus the shelf life is shorter. Basically, a food with a_w of less than 0.6 is microbiologically stable and if any spoilage occurred, it is only due to the chemical reactions rather than by microorganisms (Goula and Adamopoulos, 2005 ; Kanparo *et al.* 2012). The initial pH of the sample was found to be 4 and total soluble solids was calculated as 35^{o} Brix. The β-carotene content of the extract powder was 304 µg in 100 g. Carotenoid pigment provide a natural colour to the powder. Further it was observed natural colour was obtained in free flow form without anticaking problem, if it is packed in air tight preferably packed in metalized polypropylene bags, the shelf life and colour retention will be maintained.

Colour intensity

The colour value L* was found to be 181.05, a* - 9.33and b* was found to be 56.06 and it had higher hue angle which indicated that the product was appeared as pale yellow in colour. The lightness of the powders was considerably affected by maltodextrin concentration. Due to higher maltodextrin level and higher inlet temperature, thermal degradation and rapid oxidation could be occurred that resulted in low a* and b* value and high hue angle led to lower colour, the similar findings was observed by Tuyenckha *et al.,* 2010.

c. Sensory evaluation of foot yam colour powder

Elephant foot yam colour powder was accessed its sensory attributes (Fig. 2) The overall acceptability score was recorded as 8.2 and it was noticed that powder had a good flavour and light appealing colour which was highly attracted the panel of judges. The score values for individual attributes ranges from 8.0 to 8.4. From the sensory panelists it results, this natural food colourant could be used in flavoured milk, ice cream and puddings etc.

Fig 2. Bio colour from elephant foot yam

CONCLUSION

From the study it was concluded that the colour extracted from elephant foot yam had light yellow in colour. This yellow colour is due to the presence of carotenoids. The powder was highly accepted by the panel of judges. It could be used for the processed foods like puddings flavoured milk and ice cream etc. The shelf life study of the colour need to be studied to assess the stability during storage.

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