# The potential of teak (*Tectona grandis* Linn.f.) leaf extracts as a food colourant

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## Abstract
*The suitability of teak (Tectona grandis) leaf extracts as a food and drinks colourant was investigated. Some tender and dried leaves were plucked and the colour was extracted by distillation using methanol. The colour extracted was studied for possibility of utilizing it as food colourant. The results show that the pink coloured extract contains some essential elements including Zn (0.0001mg/l), Mg .( 0.0005mg/l), Cd (0.00025mg/l),Pb.(0.0003mg/l); M n(0.0007mg/l) ;Cu (0.00095mg/l) and some tolerable level of other metals when compared with the joint United Nations/World Health Organisation's Standard. It is thus not dangerous for human consumption and could therefore be used as a food and drink colourant. The technic for the establishment of teak plantation is already well understood while the ecoclimate in many parts of Nigeria is suitable for its growth. It is advised that industries wishing to use teak leaf as raw material in food colouring must establish plantations of the tree to ensure regular supply and to ensure that the existing resource base is not overstressed. Such plantations are better established in the rural areas where the traffic is light and the risk of lead accumulation in plant tissue is minimal. Leaf harvesting must be at a level that would not affect the physiology of the trees and the tender leaves at the actively growing apical portion of the plant should not be harvested.*

Keywords: Food; Colourant; Methanol ; Extraction; *Teak leaves.*

## Introduction

One of the groups of raw materials that contribute significantly to economic development, industrial growth and general welfare of the world's teeming population is forest produce. As a result of the enormous contribution of forest produce to the economy, exploitation of forests in recent times has assumed a devastating dimension. Though timber is the major forest product, there are other non-timber forest products (NTFPs), which are collected from both rural, and urban forests. These are also of great importance as they are harvested for domestic and commercial purposes. They include medicine, edible fruits, craft materials, recreation and ecological services. In timber trading, teak (*Tectona grandis* Linn. F.) is one of the trees species, which contribute significantly to the economy of Nigeria. Since teak was introduced to Nigeria, all of its parts have been of economic importance. These parts may be its straight bole, which is processed and used as electric, or telecommunication transmission pole or converted into planks for furniture and carpentry works. The leaves are also used locally as a wrapper for the packaging and preservation of food. The branches of the felled teak tree are cross cut and packed for fuel wood. The plant is propagated from seeds and stumps.

The production of enough food to feed the country is one of the inter-related food resource problems. Another problem is food quality, whether the food has enough nutrients necessary (proteins, vitamins, minerals etc.) to prevent malnutrition (FAO, 1996). One of the least transparent sectors of food ingredient is a colouring agent. Food industries in an attempt to improve the quality and acceptability of food and drinks have introduced food additives such as sweeteners, preservatives and colourings. According to FAO (1993), consumers have expressed concern about the safety of food additives, agricultural and veterinary chemical residues, biological, chemical and physical contaminants. According to FAO (1993), food colouring may mask the inferior quality of a food or be harmful. One means by which the problem is being addressed is through the establishment of food quality and safety standards. This has been the role of the Joint UN /WHO food standards programme since 1962.

Obviously food industries commit a lot of resources into the procurement of synthetic colouring agents. This has a lot of implications on food security and safety, not only in terms of risks of food poisoning but also in terms of economic access to food. Presently many people are turning to the use of natural products (in place of synthetic ones) for food and drugs. This is not unconnected to the realization of the fact that many synthetic products contain some components that may have long-term side effect on human beings. There are many plants which leaves or fruits possess attractive pigments and have been in use by the local people for ages without any known adverse effects and which could be sourced easily locally at very reduced cost. A few examples of these in Nigeria include: *Vitex doniana*,(fruits) *Syncepalum dulcificum* (fruits); *Sorghum bicolor(stem)* and *Parkia biglobosa(seed pulp)*; there are many of such plants, which have potentials of being used as food additives but most of these, have not been scientifically proven to be fit for human consumption. In Nigeria presently, most food industries like wine and juice industries depend largely on synthetic colourants for their final products. Teak leaf extract has a natural colouration which can be of good use to these food and drink industries if found to be safe for human consumption. This colour can be scientifically extracted and used as food colourant. The need to evaluate teak leaf which is a natural produce and likely to possess essential nutrients needed by human, as a very good substitute for synthetic food colourant motivates the present study.

## Objective of the study

The objective of the study is to investigate the suitability of teak leaf extracts for food colouring.

## Materials and Methods

### Extraction of colour

Average sized leaves of teak about 40cm long by 25cm broad, were plucked from its stands located in the *Gmelina* plantation of Federal College of Forestry, Jericho Ibadan. The leaves were taken to the soil and plant laboratory, Institute of Agricultural Research and Training (IAR&T) Moor Plantation, Ibadan for analysis.

The samples were weighed and then ground with the aid of grinding machine and packed into the tumble. The tumble was placed in the extractor and fitted up with reflux condenser and a 250ml soxhlet flask, which had been previously dried in the oven, cooled in the desiccators and weighed. The soxhlet flask was filled to 75% of its capacity with methanol (reagent) and was heated for six hours. The constantly running water from the tap aided condensation of the vapour formed from the heating.

The colour was left to siphon over for at least 10-12 times until it was short of siphoning. The colour content of the extractor was carefully drained into the colour stock bottle. The tumble containing the sample was then removed and dried on a clock glass on the bench top. The extractor, flask and condenser were replaced and the distillation continued until the flask was partially dried.

### Determination of heavy metals and trace element contents of teak leaf colour_extract

100mls. of the extract was measured into digestion tube and was made upto 1 litre with distilled water to dilute and neutralize the colour extract. The colour was then filtered into 1000mls flask and read on atomic absorption spectrophotometer for the presence of macro elements: (Sodium, (Na), Chlorine (Cl), Potassium (K), Iron (Fe), Calcium (Ca) and Phosphorus (P) and; the micro elements: Zinc (Zn), Magnesium (Mg), Cadmium (Cd), Lead (Pb), Manganese (Mn) and Copper (Cu). The elements were then read on atomic absorption spectrophotometer at different wavelengths and lamps.

## Results and discussion

### Colour detection

The colour extracted from teak leaf is identified to be pink with the aid of colour chromatography. The elements detected from the laboratory examination of the collected sample leaves and the UN /WHO maximum allowable concentrations in human food are shown in Table 1.

**Table 1: Elements present in teak leaf extract and the UN/WHO maximum allowable concentration**

| Elements | Quantity present in Teak leaf extract (ppm or mg/l) | UN/WHO maximum allowable concentration (ppm or mg/l) |
|---|---|---|
| Zinc (Zn) | 0.0001 | 5.0 |
| Magnesium (Mg) | 0.0005 | 15.0 |
| Cadmium (Cd) | 0.00025 | 0.005 |
| Lead (Pb) | 0.0003 | 0.05 |
| Manganese (Mn) | 0.0007 | 0.1 |
| Copper (Cu) | 0.00095 | 1.0 |

Source: World Health Organisation (1984)

From Table 1, it is confirmed that teak leaf – extract contains the following microelements: Zinc (Zn), Magnesium (Mg), Cadmium (Cd), Lead (Pb), Manganese (Mn) and Copper (Cu). Some of the above listed elements are highly toxic and these include Cadmium (Cd) and Lead (Pb) which are heavy metals. Since it has been analytically confirmed by comparison with the UN/ W.H.O. standard that the concentration of each of the elements per milligram per litre (Mg\l) of liquefied colour extract of teak leaf is very low, the concentration of these metals in the leaf extract could be said to be within tolerable level for human consumption.

Ingen and Chansen (1989) and Latham (1998) observed that mineral nutrients are required in the structural composition of hard and soft tissues and in such processes as enzymatic reactions, muscular contraction, and nerve reactions and in blood clotting. According to them, Magnesium is essential for maintaining the electrical potential in nerve and muscle cells and its deticiency may lead to tremors and convulsion; Copper and Zinc are important in forming enzymes whose deficiency may impair growth or cause dwarfism in severe cases. Zinc is involved in vital physiological functions such as membrane stabilization and as essential components of enzymes such as thymidine, linase, DNA and RNA polymerases. Callender (1972) and Chvapil, (1973) also reported that Iron is required in human body for the manufacture of haemoglobin, which carries oxygen to the various body organs. Furthermore, Chandra (1981) reported that the presence of zinc in appropriate quantity in human body helps to improve immunity particularly against fungi.

The concentration of magnesium in teak leaf extract is 0.0005ppm, which is far below 15.0ppm maximum allowable concentration of UN/WHO (1984). Similarly the 0.00025ppm of Cadmium observed in the teak leave extract is far below the 0.005ppm UN/WHO allowable standard. The concentration of lead is also 0.0003ppm compared to the0.05ppm allowable standard. The concentrations of manganese and copper in teak leaves extract are 0.0007ppm and0.00095ppm. respectively. These are far below the UN/WHO allowable standards of 0.1ppm and 1.0ppm respectively (Table 1). This eliminates the fear of over concentration of these elements in human body. The list of nutrients considered essential for human health is constantly increasing. According to (UN/WHO 1983) the ninth edition of the Nutrition Research Council's Recommended Dietary Allowances (1) has included six additional trace elements - copper, manganese, fluoride, chromium, selenium, and molybdenum. Thus the use of the teak leaf extract as a food colourant could even contribute to the supply of essential nutrients for

human health at least to a reasonable minimum limit.

Similarly some heavy metals like Pb.and Cd. are present in the extract but their concentration levels are far below the UN/WHO maximum allowable concentrations for such elements. Though, cases of human toxicity from heavy metals such as Pb, Hg, Al and Cd. are common, these are almost exclusively traced to accidental contamination rather than through natural occurrences (Hui, 1992). According to him ingestion of at least ten times normal levels would be required to approach toxic proportions of most essential minerals except in cases of Mo and Cu where levels can reach toxic quantities when plants are grown on soils unusually high in these minerals. According to Bassuk (1983) Lead contamination is possible in two ways for plants grown in urban environments. It could be through direct deposit on the leaves surfaces from leaded fuels or from lead based paints. In Nigeria the former is more likely than the latter. It will therefore be advisable that teak trees to be used for the supply of leaf raw material for colour extraction should be planted in rural areas where traffic is very low and contamination from fuel residues is very minimal.

In addition to possessing acceptable level of some metals, which have been reported to be essential for normal physiological functions of human body (Hambidge 1978), the extract was not found to possess any repulsive odour that may render it unacceptable to potential consumers. Its pink colour is also attractive and adds to its value as a potential food colourant. The primary source of raw material, that is the teak plant could be readily sourced from plantations and farmlands at very affordable costs. Teak grows readily in most tropical environments. Old plantations of teak are found in various parts of Nigeria such as the South-West and the middle belt. The planting stock such as root stumps and seeds could be sourced from existing plantations and Forestry Research Institute of Nigeria (FRIN), Ibadan. The nutrition, growth, pathology and regeneration characteristics of the species have been studied extensively at the Department of Forest Resources Management University of Ibadan and FRIN, Ibadan. Hence the necessary Silvicultural knowledge for its plantation establishment is readily available

The implication of the findings of this study is that the teak leaf extract could be useful as a food colourant and its consumption at such a minimal level could actually be beneficial to human body. The teak plant is very tolerant to leaf harvesting. Its leaves have been harvested for various purposes for many years without observed serious negative effects on the plant. Also the plantation of the species could be established easily in many parts of the tropics. However, there may be the temptation for harvesters to want to concentrate on the more succulent growing apical leaves for the production of the extract. This could be inimical to the growth of the plant and should not be encouraged.

Teak is easy to grow and does well in Nigeria's eco-climatic environments. Its production in a large scale for the supply of leaves is therefore not likely to be a problem to potential investors. As earlier pointed out, teak stand if properly managed could produce, other outputs such as poles and timber in addition to the leaves, which is the main target.

## Conclusion and recommendations

The potentials of teak leaf extract, as a food colorant is high. The pink colour is attractive and the extract does not emit any offensive odour. More importantly, the concentrations of the heavy metals found in the extract are within the UN/WHO allowable standard for human consumption. In addition, useful macro elements such as K, Na, Cl, P, Fe and Ca were found in the extract. These have been variously reported to be useful in human body. The colour extract is thus not likely to pose any danger to human health if consumed. Food industries may therefore consider the adoption of this extract as a food colourant.

Teak is presently under intense pressures in Nigeria for utilization as timber. This had greatly reduced the stock. It is, therefore, advised that any industry willing to adopt its leaf extract, as a food colourant should establish its plantations. In Nigeria availability of land for the establishment of forest plantation is often a problem. Thus forestry projects are pushed to marginal lands, which are otherwise not suitable for agriculture. This type of

land is usually with soils of low organic matter contents. Organic matter binds the metals in the soil together thereby reducing the risk of getting into plants. It is, therefore, advised that teak trees to be used for the supply of the colour extracts should be planted on soils rich in organic matter to reduce the risk of heavy metal contamination through the roots. Leaf harvesting may start as from age eight and this may continue for as long as the plant lives. The best method of regeneration at successive rotations would be by coppicing. This will ensure the production of copious shoots with many leaves, which could be harvested. Leaf harvesters should however harvest leaves at the middle and lower parts of the plant leaving the younger actively photosynthesizing leaves at the apical portion of the plant. Further research in to the stability of the colour extract over time and possible reaction with other chemical components of food should be carried out.

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