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DARS 956-13

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African Traditional Medicine – Medicinal plant standards – *Irvingia gabonensis* FHI110954

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Table of contents

Foreword

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This African Standard was prepared by the ARSO Technical Committee on African Traditional Medicine (ARSO/TC 82).

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Introduction

Irvingia gabonensis belongs to the Irvingiaceae family, it is a tree native to West Africa. The fruit is similar to a mango whose seed is used for preparation of a delicious viscous soup for swallowing yam and cassava puddings. The seeds are used to make medicine. It is commonly known as African mango, wild mango, bush mango or Dikanut (Mustapha and Taleat 2014). The seeds and the seed extracts of IG have many health benefits, including the management of the different components of metabolic syndrome and oxidative stress as a result of its rich content of various bioactive phytochemicals.
There are two well-known edible species of *Irvingia* in West Africa; *Irvingia gabonensis* and *Irvingia wombolu*. The table below summarizes the physical differences between the two (2) species.

Property	**Irvingia gabonensis**	**Irvingia wombolu**
Taste	*Sweet*	*bitter*
Common name	*Bush mango*	*Ugili*
Seeds shape	*Flattened*	*Curved*
Seeds size	*Bigger & smoother*	*Smaller and rough*
As soup thickener	*less thickening*	*more thickening*
Mesocarp	*Edible flesh*	*Non-edible flesh*

The fruits of I. *gabonensis* are seasonal between April to September and December to March (Mateus-Reguengo et.al., 2019). The fruit of the plant is a large drupe with fibrous flesh, with the fruit pulp being palatable, used for beverages and for Jam production forming part of the staple diet of Nigerian and Cameroonian tribes (Raj et al., 2022). The fruit kernel known as Apon, Ogbono, Ogwi and Egili in various tribe in west African is the most important product (Ezekiel et al., 2016; Nwosu *et al*., 2005). It is used as soup thickener by sun drying and grinding into flour.

African Traditional Medicine- Medicinal Plants Standards- African Bush Mango (*Irvingia gabonensis)*

1 Scope

This Standard specifies requirements and related tests methods for *Irvingia gabonensis* raw material to be used in consumer products including health, health food, medicinal and industrial products

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

AOAC Official Method 2008.02, Aflatoxins B1, B2, G1, and G2 and Ochratoxin A in ginseng and ginger by multi-toxin immunoaffinity column clean up and Liquid Chromatographic Quantitation

ARS 53, *General principles of food hygiene — Code of practice*

ARS 56, Pre-*packaged foods — Labelling*

ARS 950, *ATM - Terms and terminology*

ARS 952, *Guidelines on Good Agricultural and Collection Practice (GACP) for Medicinal Plants*

ARS 955, *African Traditional Medicine — Technical guidelines for safety, efficacy and quality of raw materials and herbal medicines*

CODEX STAN 150, *Standard for food grade salt*

CODEX STAN 192, *General standard for food additives*

CODEX STAN 193, *Codex general standard for contaminants and toxins in food and feed*

CODEX STAN 1:1985; *Rev. 8:2010, General Standard for the labelling of Pre-Packaged food*

USP 30, NP 25, (2007), *United States Pharmacopeia 30, National Formulary 25, 2: 1-1256*

3 Terms and Definitions

In addition to ARS 950-2016, ATM - Terms and terminology, the following definitions shall apply for the purpose of this standard.

3.1
Disclaimer
a statement that you are not responsible for the effects or usage of the medicinal plant that has not gone through clinical trials

3.2
Clinical trials
a type of research that studies new tests and treatments and evaluates their effects on human health outcomes

3.3
Hull
Seed coat product dried and milled without the processing or removal of any component

3.4
Seed powder
Seed product dried and milled without the processing or removal of any component

3.5
Sustainability
Using methods, systems and material by conserving an ecological balance and avoiding depletion of resources or harm to natural cycles

3.6
wild growing
plants growing in their natural native habitat in an ecological area and applies to uncultivated plants wherever they may be found and is not necessarily limited to wilderness areas

4 Guidelines for production, harvesting and handling

4.1 General requirements

4.1.1 The production of *Irvingia gabonensis* raw material shall comply with applicable regulations e.g Good Agricultural and Collection Practices (GACP) (ARS 952:2016).

4.1.2 Specific, designated, clean containers shall be used for the intended type of raw material during collection and processing. Containers that have previously been used to store other substances, e.g. chemicals, shall not be used. New bags or containers should be used which are labelled with the following information: Name of collected plant, collection area, collector name, date of collection, weight.

4.1.3 The raw material shall be free from extraneous matter, e.g. stones and twigs.

4.1.4 Workers shall wear hairnets, or any other suitable head cover, and gloves when collecting the raw material to maintain hygiene standards and avoid introduction of foreign matter.

4.1.5 An adulterant shall not be added to the raw material. Supplementary shall be declared.

4.1.6 In order to maintain a high standard of hygiene, workers in the manufacturing facility shall wear hairnets, or any other suitable head cover, and gloves when the raw materials are processed.

4.2 Harvesting requirements

In addition to the general requirements in ARS 952:2016, the following specific harvesting requirements shall apply to organic, cultivated and wild growing of the medicinal plants

4.2.1 Harvesting of *Irvingia* shall be done in cultivated sites or locations where agrochemicals and industrial run-offs do not occur.

4.2.2 Harvesting shall not take place in areas likely to be contaminated with heavy metals such as dump sites or mining areas (Olowu *et al*., 2015).

4.2.3 Only healthy and matured undamaged seed shall be harvested fresh, by hand, with knifes, scissors, sickles, and stabs with hooks attached.

4.2.4 The raw material shall be collected early in the day after the dew has dried though it can be gathered any time of the day after it is dry. Harvesting shall not take place when raining.

4.2.5 Inspections shall be done to avoid the inclusion of excessively damaged material.

4.2.6 Plant material shall be delivered to the processing area as soon as possible as plants will grow mould and begin to oxidize quickly after harvesting.

4.2.7 Harvesting period: Field collection of *Irvingia gabonensis* from the wild take place between June – August.

4.2.8 Postharvest Handling Processing

4.3 Cultivation

4.4 Storage

5 Requirements

5.1 Quality requirements

5.1.1 Microbiological limits

The product shall comply with the microbiological limits given in Table 1 when tested in accordance with the test methods specified therein.

Table 1 — Microbiological limits for Irvingia gabonensis

S/Nr	Parameters	Limits	Test Methods
A.	Raw medicinal plant and herbal materials intended for further processing (including additional decontamination by a physical or chemical process).		
1	Yeast and moulds, max. Per g	107	USP 30, NF 25
2	E. coli, max per g	absent	“
3	Shigella, per g	absent	“
B. Herbal materials that have been pre-treated (For herbal materials that have been pre-treated (e.g with boiling water as used for herbal teas and infusions) or that are used as topical dosage forms)			
4	Aerobic bacteria/g	105	USP 30, NF 25
5	Yeasts and moulds, max. Per g	104	“
6	E. coli, max. Per g	102	“
7	Enterobacteria and certain Gram- neg. Bact./g	103	“
8	Salmonella, per g	absent	“
9	Shigella, per g		
10	Clostridia, per g		
C	Other herbal materials for internal use		
11	Aerobic bacteria/g	103	
12	Yeasts and moulds, max. Per g	104	“
13	Escherichia coli, max. Per g	Absent	“
14	Salmonella, per g	“	“
15	Enterobacteria and certain Gram-neg. Bact./g	“	“
16	Clostridia, per g		
17	Shigella, per g		
D	Herbal medicine to which boiling water is added before use		
18	Aerobic bacteria/g	106	USP 30, NF 25
19	Yeasts and moulds, max per g	104	“
20	Escherichia coli, max per g	Absent	“
21	Salmonella, per g	“	“
22	Enterobacteria and certain Gram- neg. Bact/g	103	“
23	Clostridia, per g		
24	Shigella, per g		

5.1.2 Chemical, physical and mycotoxin requirements

The product shall comply with the Chemical, physical and mycotoxin requirements given in Table 2 when tested in accordance with the test methods specified therein.

Table 2 — Chemical, physical and mycotoxin requirements

S/N	Characteristics	Limits(seeds)	Ref. Test methods
1	Lead (pb), max. mg/kg	20µg per gm	USP 30, NF 25 Pge 231
2	Cadmium (Cd), max. mg/kg	"	"
3	Arsenic (As), max. mg/kg	"	"
4	Chromium (Cr), max. mg/kg	"	"
5	Mercury (Hg), max. mg/kg	"	"
6	Copper (Cu), max. mg/kg	20µg per g	"
7	Total ash (aerial parts), max. %	4 – 8%	USP 30, NF 25
8	Total ash (roots), max. %	"	"
9	Acid – insoluble ash (leaves), max. %	2%	"
10	Acid – insoluble ash (roots), max. %	4 – 8%	USP 30, NF 25
11	Foreign matter, max. %	2 – 3 %	USP 30, NF 25
12	Total Aflatoxin (AFB1 + AFB2 +AFG1 +AFG2), ppb	2ppb	AOAC 2008.2
13	Aflatoxin B1 only, ppb	4ppb	"

The inputs and Methods are based on USP 30, NF 25 of May 1, 2007.
Aflatoxin Test Method is from AOAC 2008.2

5.1.3 Pesticide residues

For use of pesticides, reference shall be made to the CODEX list of approved pesticides for spices and their maximum residue limits (MRLs) (WHO, 2007).

5.1.4 Physicochemical parameters

5.1.4.1 The product shall comply with the Physicochemical requirements given in Table 3 when tested in accordance with the test methods specified therein.
Physicochemical properties of the pulp & Seeds (Onimawo et al., 2003).

Property	Pulp	Seed
moisture	80%	3%
crude protein,	1%	8%
crude fat	1%,	66%
mineral ash	1%	2%
crude fiber	0.5%	10%
carbohydrate	11%	11%
calcium	262mg per 100g	
vitamin C	66.7mg per 100ml	

Note to entry: The high moisture content of the edible pulp provide evidence for its use in the production of juice, while the low ash content indicates a low mineral content (Oboh et al., 2004).

5.1.4.2 Determination of ash values:

5.1.4.3 Extractive values

5.1.4.4 Determination of loss on drying (Moisture content)

5.1.4.5 Radioactive residues

The WHO guidelines emphasize that the health risk, in general, due to radioactive contamination from naturally occurring radio nuclides is not a real concern, but those arising from major nuclear accidents may be serious and depend on the specific radionuclide, the level of contamination, and the quantity of the contaminant consumed. Taking into account the quantity of herbal medicine normally consumed by an individual, they are unlikely to be a health risk. Therefore, at present, no limits are proposed for radioactive contamination (WHO, 2011).

5.1.4.6 Determination of pH values:

Pulp- slightly acidic (pH – 5.8) (Onimawo et.al., 2003)

5.1.4.7 Presence of additives

In the case where additives are added, the quantity and type of additive shall be declared by the supplier.

5.1.4.8 Sustainability

Irvingia gabonensis, a substantial quantity of its fruit or seed is still being sourced from the wild. They are also found in compound farms and in protected in Cocoa, cola and coffee plantations. 60% of its fruits for eating and for their kernels are collected from the wild forest, 10% from the compound farm garden and 30% from the outlying fields (Ladipo, 2003).
To ensure a viable and sustainable production system of Irvingia, there is need to maintain sufficient product of it in its season while the genetic resources of the species are adequately consumed and protected.

- For example, ICRAF has embarked on a programme of genetic resources collection and conservation and the utilization of high value materials in agroforestry systems.
- And seedling stocks selected from high value mother trees, planted in farmers to reduce the pressure on natural forest trees.
- put in place proper and viable new 'supportive' plantings in the degraded forests.
- to try the old systems of enrichment planting which will support the ecological status of the forests and also enhance its productivity (Irvingia kernels).
- need for the establishment of pure commercial plantations will help and ensure sustainable production of Irvingia (Ladipo, 2003).

5.1.5 Adulterants and adulterations

There shall be no adulterant.

6.0 Packagin

In addition to the requirements in ARS 56, Pre-packaged foods — Labelling, the following shall apply:

6.1 The *Irvingia gabonensis* raw material shall be packed in acceptable containers that will withstand normal usage and transportation and prevent any risk of contamination and significant losses.
6.2 Raw material sensitive to light shall be packed in containers that are light-resistant
6.3 Liquid raw material shall be packed in leak-proof containers.
6.4 List of ingredients should be declared
6.5 Powdered raw material shall be packed in clean containers and placed inside an airtight container.

7.0 Labelling

In addition to the provisions of ARS 56, Pre-packaged foods - Labelling and Codex Alimentarius Commission (CODEX STAN 1-1985; Rev-8-2010) on General Standard for the labelling of Pre-Packaged food, the following shall be inscribed on the package:

a) name of the product (type of raw material);

b) species

c) date and method of collection (i.e., wild or cultivated);

d) geographical origin of the species;

e) classification or grade, e.g., pharmaceutical grade or food grade;

f) name and address of the manufacturer, packer, co-packer, distributor, importer, exporter or vendor;

g) code or batch number;

h) net weight of product in grams;

i) date of packaging and best before date shall not be in code for the benefit of consumers;

j) producing country or country of origin;

k) mark of quality;

l) other regulatory marking as appropriate;

m) name of additive, if present; and

n) disclaimer of the product will be added if there is no evidence of clinical trials.

NOTE The symbol for organic certification may be exhibited on products that have organic certification.

Annex A
(informative)

Determination of foreign matter

A.1 General

A.1.1 Herbal drugs should be free from moulds, insects and other animal contamination.

A.1.2 Foreign matter is material consisting of any or all of the following:

a) Foreign organs: matter coming from the source plant but not defined as the drug,

b) Foreign elements: matter not coming from the source plant and either of vegetable or mineral origin.

A.2 Determination of foreign matter

Weigh 100 g to 500 g of the substance to be examined, or the minimum quantity prescribed in the monograph, and spread it out in a thin layer.

Examine for foreign matter by inspection with the unaided eye or by use of a lens (6X). Separate foreign matter and weigh it and calculate the percentage present.

Annex B
(informative)

Sampling procedures

B.1 General

The following sampling procedure shall be applied in determining whether a lot submitted for inspection and testing complies with the relevant requirements of this standard. The sample so drawn shall be deemed to represent the lot.

B.2 Definitions

B.2.1
batch
defined quantity of material produced from a single process or, in the case of a continuous production process, the material produced in a defined cycle of manufacture that is intended or purported to be homogeneous in character and quality

NOTE Small batches may be combined and blended together to form a uniform batch.

B.2.2
defective
raw material that fails in one or more respects to comply with the requirements of this standard

B.2.3
lot
the quantity of O*. gratissimum* raw material that bears the same batch identification, from one manufacturer, and submitted at any one time for inspection and testing

B.3 Sample for inspection

The seeds shall be visually inspected for damage, discolouring or disease. Infected ones shall be discarded.

B.4 Sample for testing

B.4.1 Sampling of products

B.4.1.1 Take 3 g of powdered sample from the top, middle and bottom of each container per batch of product.

B.4.1.2 Transfer into a clean, dry, air-tight container clearly marked with the sample identification, batch number and date of sampling.

B.4.1.3 Take a composite of each sampling container and mix a sufficient amount for all the required tests.

B.4.1.4 Store the remainder of the samples for retention purposes.

B.5 Compliance with this standard

The lot shall be deemed to comply with the requirements of this standard if, after inspection and testing of the samples taken in accordance with B.1, B.3 and B.4, no defective is found.
B.4.1.5 Store the remainder of the samples for retention purposes.

B.5 Compliance with this standard

The lot shall be deemed to comply with the requirements of this standard if, after inspection and testing of the samples taken in accordance with B.1, B.3 and B.4, no defective is found.

Annex C
(normative)

Determination of loss on drying

C.1 Apparatus and glassware

C.1.1 **Drying oven**, capable of operating between (100-110)°C ± 1

C.1.2 **Balance**, accurate up to three decimals.

C.1.3 **Desiccator**.

C.1.4 **Sample holder**.

C.2 Procedure

C.2.1 Determine the mass of the sample holder.

C.2.2 Accurately weigh approximately 20 g ± 0.1 g of sample into the holder.

C.2.3 Dry in an oven at 105 °C ± 1 °C for 24 h.

C.2.4 Cool in a desiccator for 30 min to 60 min.

C.2.5 Determine the mass of the holder with the sample to the third decimal without delay.

C.3 Calculation

Calculate the loss on drying using the following formula:

$$L = \frac{B - C}{B - A} \times 100$$

where

L is the loss on drying as a mass fraction, expressed as a percentage;

B is the mass of the sample holder and sample before drying, in grams;

C is the mass of the sample holder and sample after drying, in grams;

A is the mass of the sample holder, in grams.

Annex D
(normative)

Determination of ash values

D.1 Apparatus and glassware

D.1.1 Crucible (Platinum or silica).

D.1.2 Balance, accurate up to three decimals.

D.1.3 Muffle furnace, capable of operating between 400 °C ± 1 °C and 800 °C ± 1 °C.

D.2 Reagents

D.2.1 Hydrochloric acid (70g/L)

D.2.2 Distilled water.

D.3 Determination of Ash

D.3.1 Total ash

Heat a silica or platinum crucible to redness for 30 min, allow to cool in a desiccator and weigh. Unless otherwise prescribed, evenly distribute 2 g - 4 g of the substance or the powdered vegetable drug to be examined in the crucible. Dry at 100 °C to 105 °C for 1 h and ignite to constant mass in a muffle furnace at 600 °C ± 25 °C, allowing the crucible to cool in a desiccator after each ignition.

Flames should not be produced at any time during the procedure. If after prolonged ignition the ash still contains black particles, take up with hot water, filter through an ashless filter paper and ignite the residue and the filter paper. Combine the filtrate with the ash, carefully evaporate to dryness and ignite to constant mass.

Allow the residue to cool in a suitable desiccator for 30 minutes, and then weigh without delay. Calculate the content of total ash in mg per g of air-dried material.

D.3.2 Acid-insoluble ash

To the crucible containing the total ash, add 25 ml of hydrochloric acid (~70g/l) TS, cover with a watch-glass and boil gently for 5 minutes. Rinse the watch-glass with 5 ml of hot water and add this liquid to the crucible. Collect the insoluble matter on an ashless filter-paper and wash with hot water until the filtrate is neutral.

Transfer the filter-paper containing the insoluble matter to the original crucible, dry on a hot-plate and ignite to constant weight. Allow the residue to cool in a suitable desiccator for 30 minutes, then weigh without delay. Calculate the content of acid-insoluble ash in mg per g of air-dried material.

D.3.3 Water-soluble ash

To the crucible containing the total ash, add 25 ml of water and boil for 5 minutes. Collect the insoluble matter in a sintered-glass crucible or on an ashless filter-paper. Wash with hot water and ignite in a crucible for 15 minutes at a temperature not exceeding 450°C.

Subtract the weight of this residue in mg from the weight of total ash. Calculate the content of water-soluble ash in mg per g of air-dried material.

Annex E
(Normative)

E.1 Raw material presentations

Tree of *Irvingia gabonensis* vs *Irvingia wombolu*
Source: Atoyebi, *et. al.*, 2020

Unripe *Irvingia gabonensis* fruits

Unripe *Irvingia wombolu* fruits

Source : Etebu, E. 2012

		
Fruits of *I. gabonensis*	**Tree of *Irvingia gabonensis***	**Leaves of *I. gabonensis***

Source: *https://korupplants.myspecies.info/taxonomy/term/201*	Source: *http://www.fruitipedia.com/2018/12/dika nut_irvingia-gabonensis/*	Source: *https://www.pngwing.com/en/free-png-bzdqd*

***Irvingia gabonensis* Seeds**
Source: Jemilat Ibrahim, NIPRD 2022

E.1.1 Organoleptic properties

The product shall comply with the Organoleptic properties given in Table 4.
The characteristic difference between the two species is on the morphology and organoleptic properties

Table 4:

Property	***Irvingia gabonensis***	***Irvingia wombolu***
Taste	Sweet	bitter
Common name	Bush mango	Ugili
Seeds shape	Flattened	Curved
Seeds size	Bigger & smoother	Smaller and rough
As soup thickener	less thickening(slimy)	more thickening(slimy)
Mesocarp	Edible flesh	Non-edible flesh

E. 1.2 Macroscopic characteristics

Macroscopic characteristic differences between IGG and IGW leaves.

CHARACTERS	**IGG**	**IGW**
Habit	**Tree**	**Tree**
Leaf colour	Dark green	Drying blackish or greenish green
Leaf texture	Leathery and glossy above	Less leathery
Leaf apex	Tapering and occasionally acute acumen	Rounded with blunt acumen
Leaf base	Acute to cuneate	Obtuse to acute
Leaf shape	Elliptical	Elliptic to obovate
Leaf arrangement on stem	Alternate	Alternate
Petiole	Present	Present
Leaf length	0.70±0.12	0.57±0.12
Leaf petiole	9.11±1.50	7.19±1.44
Leaf width	2.91±0.42	2.09±0.53

Total leaf length	9.82±1.54	7.76±1.50
Venation	Loosely reticulate	Loosely reticulate
Leaf type	Simple	Simple
Leaf blade	Entire	Entire

Key: IGG—*Irvingia gabonensis* var. *gabonensis;* IGW--- *Irvingia gabonensis* var. *wombolu.*
Ifesanwo B.A (2018)
Msc. Project, Department of Pharmacognosy, University of Ibadan, Ibadan.

E.1.3 Microscopic characteristics

Macroscopic and microscopic examinations; solvent solubility (alcohol and water) determination and thin-layer chromatographic fingerprinting.

Microscopy

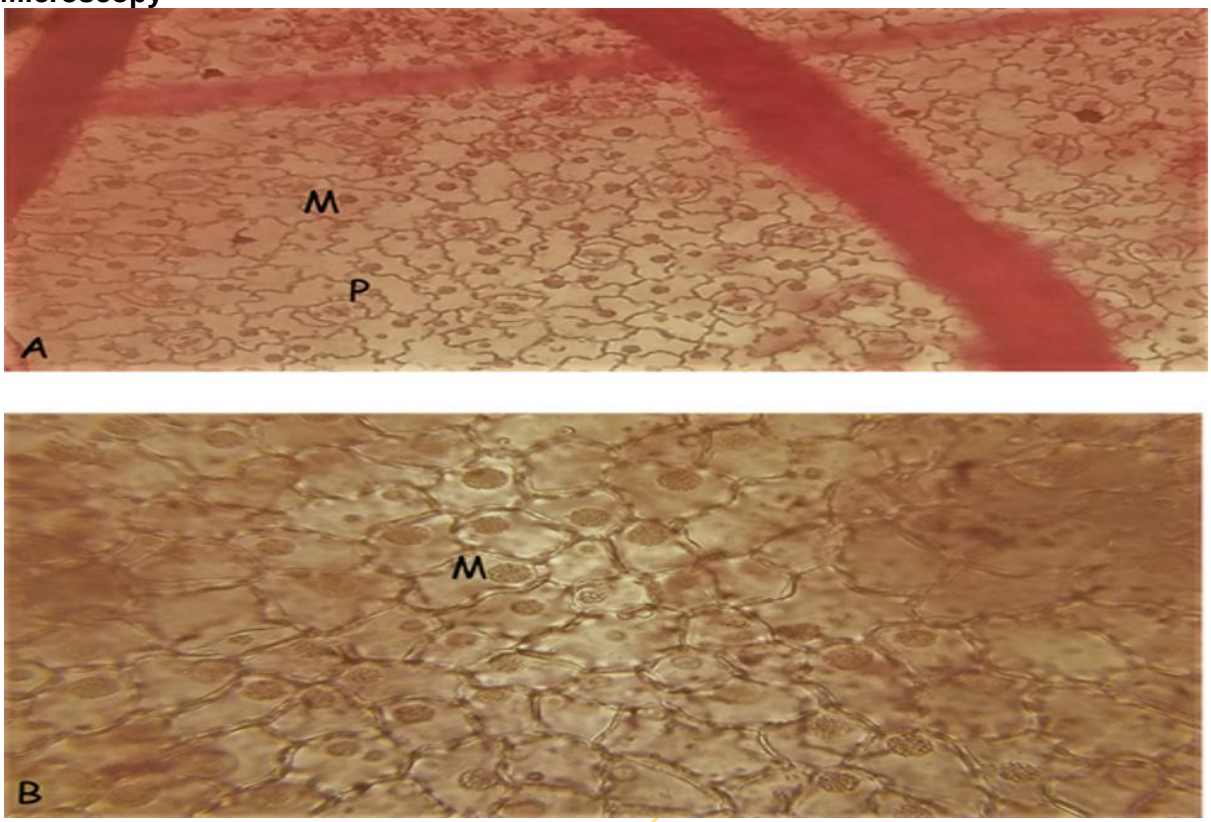

Figure 2 (A & B) Epidermal surfaces of Adaxial and Abaxial of *Irvingia gabonensis*
P-paracytic stomata, M-Mucilage

Microscopy of fresh leaves revealed the presence of paracytic and hypostomatic cells only on the abaxial surface with irregular shaped and curved wall epidermal cells on abaxial surface. The adaxial surface lacks stomata with polygonal and straight walled shaped epidermal cells. Quantitative micrometry shows 143 epidermal cells with an average of 1.1 µm in length, 1.21 µm in width and 32 stomata cells with an average of 1.16 µm in length 1.2 µm in width, on abaxial surface. On the adaxial surface, 137 epidermal cells with a n average of 1.83 µm in length, 2.03 µm in width observed (Daudu et al., 2020)

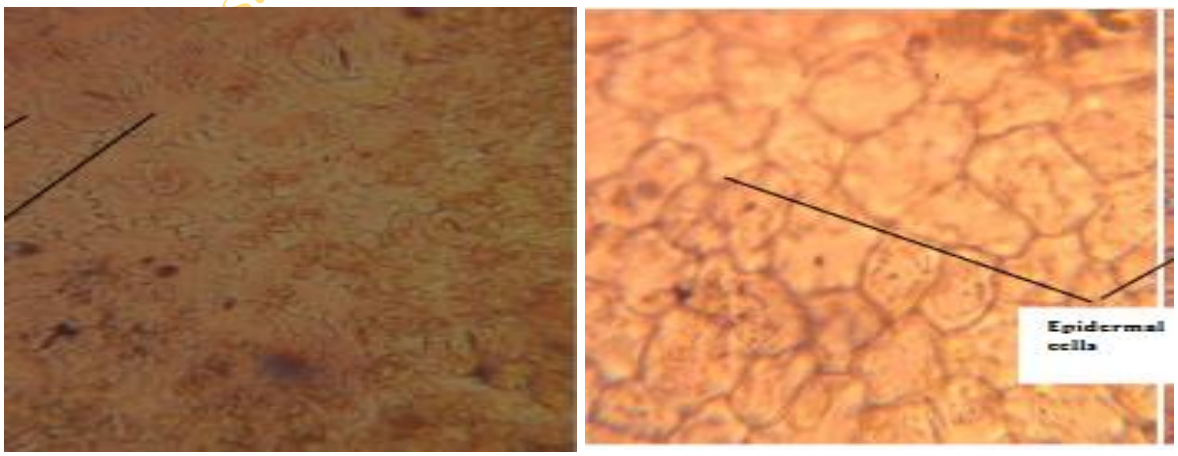

Figure1: epidermal cells and stomata on abaxial surface (a) and epidermal cells on adaxial surface (b) (Daudu et al., 2020)

E.1.4 Chemical constituents

Several studies have assessed the chemical properties of the kernels or seed and pulp of African bush mango.
An amino acid profile of fresh African bush mango seeds indicated the presence of amino acids (Ekpe *et al*., 2007). The oil content of the seed provided evidence for its use in industry and the fiber content may provide bulk, improving bowel function (Matos *et al*., 2009).

Myristic, lauric and palmitic acids compose nearly 95% of total fatty acids in Africa mango seeds (Matos *et al.,* 2009).

Seed Oil: caproic acid caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, oleic acid, erucic acid, linoleic acid, alpha-linoleic acid and arachidonic acid (Ekpe et al., 2018)

Seed extract: ellagic acid, methyl-ellagic acid,kaempferol 3-O-glucoside and quercetin 3-O-rhamnoside, methyl gallate, Terminalin (Adeseko *et al.,* 2019)

Stem bark: 3-friedelanone, betulinic acid, oleanolic acid (3), 3,3',4'-tri-O-methylellagic acid), 3,4-di-O-methylellagic acid, hardwickiic acid, 3-β-acetoxyursolic acid (Donfack *et al.,* 2010).

Annex F
(informative)

Plant description

Plant description

F.1 Scientific name with author

Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill..

F.2 Synonyms

Irvinga barter; Hook. F.; *Irvinga Caerulea* Tiegh; *Irvingia duparquettii* Tiegh; *Irvingia erecta* Tiegh; *Irvingia griffonii* Tiegh; *Irvingia hookeriana* Tiegh; *Irvingia platycarpa* Tiegh; *Irvingia tenuifolia* Hook. F; *Irvingia velutina* Tiegh; *Magnifera gabonensis* Aubry-Lecomte ex O'Rorke. *Irvingia barteri* Var. *tenuifolia* (Hook. F.) Oliv.; *Irvingia fusca* Tiegh.; *Irvingia laeta* Tiegh.; *Irvingia pauciflora* Tiegh.

F.3 Family

Irvingiaceae. Older references may list family Simaroubaceae.

F.4 Common names

African bush mango, Dika bread, Dika bread tree, Dika nut, wild mango, Sweet bush mango,

F.5 Vernacular names

Nigeria: Ugiri, Ogbono, Odika, (Igbo), apon, oro (Yoruba), biri, goro (Hausa),ogwe, uyo (Efik), Ogui (Benin)
Cameroon: Aadok (cwondo), Bulukutu, miba (Douala),
Cote d'ivoire: Borborou, kakourou(Gouro)
Congo: Eniok
Central Africa republic: Ebi
Liberia: mwiba (Bassa), Ndoka ,
Gabon: En'doe (Boulou)

F.6 Botanical description

Irvingia gabonensis is a medium tree which can grow up to 40m tall; it has an outer bark which is smooth to scaly, grey to yellow grey and an inner bark that is yellow and fibrous; it has a spherical crown which can be wide and dense.
Leaves: The leaves of the plant are alternate, simple and entire, stipules are up to 4cm long, unequal and forming a cone protecting the bud, caduceus, leaving an inner scar on the branches. The petiole is up to 5mm long.
Flowers: Flowers are bisexual, regular, small and free Sepals (1-1.5mm long) and petals (3-4mm long).
Fruit: The fruit is an ellipsoid to cylindrical drupe, occasionally closely spherical and laterally compressed minimally, yellowish when ripe, variable in size between varieties 5-7.5cm with a yellow, fibrous pulp surrounding a large seed.
Seeds: Its seeds have an outer brown testa (hull) and two white cotyledons. The genus name commemorates E.G.Irving, 1855, A Scots botanist (PROTA, 2013; Orwa *et al*., 2009).

F.7 Origin and distribution

There are seven (7) known species of the Irvingia and six (6) of which occur in tropical Africa including Nigeria. In Nigeria, the African bush mango is commonly cultivated in Southern Nigeria. The plant is indigenous to the humid forest zone of the Gulf of Guinea. It is native to Angola, Cameroon, Central

Africa Republic, Congo, Cote d'Ivoire, Democratic Republic of Congo, Gabon, Ghana, Senegal, Sierra Leone, Sudan, Uganda (Orwa *et al*.,2009) and Nigeria.

F.8 Plant part used

Seeds, leaves & stem

Annex G
(normative)

Pharmacological properties and applications of *Irvingia gabonensis*

G.1 Major ethnopharmacological uses

Nearly every part of *Irvingia gabonensis* is useful in Africa ethnomedicine. The powdered seeds are used as soup thickeners in Nigeria. In some Eastern parts of Nigeria, the seed powder is added together with *Telfairia occidentalis* to make a medicinal soup claimed to restore health and vitality. The bulb of the fruit is used to prepare juice, jam and wine. Seed is used for the preparation of a slimy soup given to nursing mothers for post-partum weight management. The stem bark is used in folk medicine for dysentery, male fertility, yellow fever, scabies and skin diseases (Iwu, 2014).
Ethnomedicinal treatments utilize the bark, kernels, leaves or roots for a variety of ailments.

G.2 Other relevant uses

Research on African Bush mango has revealed beneficial effects on Diabetes and Obesity as well as antimicrobial, antioxidant, analgesic and Gastro intestinal activities.
There is interest in using supplements containing *Irvingia gabonensis* for weight loss, lowering cholesterol levels.
Irvingia gabonensis seeds might lower cholesterol because of their high fiber content. The fiber increases removal of cholesterol from the body. Some research suggests that *Irvingia gabonensis* seeds might also affect fat cells, which might reduce fat cell growth and increase the breakdown of fats.

Diabetes: *Irvingia gabonensis* can lower blood sugar levels in people with diabetes.

G.3 Pharmacological properties

G.3.1 Analgesic

In a mouse study, the analgesic activity of a water extract from African bush mango stem bark was comparable with the narcotic analgesic morphine while the ethanol extract was comparable with the non-narcotic analgesic methimazole sodium (Okolo *et al*., 1995).

G.3.2 Antimicrobial

African bush mango leaf and root extracts have documented inhibitory activity against several bacteria and fungi (Fadare *et al*., 2008).
Potential mechanisms of action include membrane disruption by terpenoids and inactivation of microbial adhesion, enzymes and cell envelope transport proteins by ellagic acid-like compounds (Kuete *et al*., 2007).

G.3.3 Gastrointestinal

A methanol extract of African bush mango exhibited dose-dependent inhibition of indomethacin-induced gastric ulceration in mice (Raji *et al*., 2001). The antiulcer activity of several doses of the extract was comparable to that of cimetidine (50 mg/kg) and the extract also reduced gastric acid secretion and increased mucous secretion.
Another animal study in mice administered African bush mango aqueous leaf extract reported decreased gastrointestinal motility and gastrointestinal protection against Castor oil-induced diarrhoea (Abdulrahman *et al*., 2004).

G.3.4 Anti-Diabetic, Anti-cholesterolemic and Anti-Obesity Activity

Several animal studies have shown that extracts of Irvingia seeds have remarkable anti-obesity and cholesterol lowering properties (Iwu, 2016). Clinical studies have shown that addition of a supplement of 4 g/day of 'dika bread' to the diet of type-2 diabetes patients for 1 month reduced plasma glucose and lipid levels. There was remarkable reduction in the LDL + VLDL-cholesterol and triglycerides levels, while increasing the levels of beneficial HDL-cholesterol. The three ATPases of the erythrocyte membrane of the diabetic patients were significantly lower than in normal subjects (Adamson *et al*, 1990). Laboratory studies and clinical reports have confirmed the efficacy of African Bush Mango for the treatment of obesity (Ngonadi et al, 2005; Woguia et al, 2011). In a double blind randomised study involving 40 subjects (mean age 42.4 years). Twenty-eight subjects received *Irvingia gabonensis* (IG) (1.05 g three time a day for one month) while 12 were on placebo (P) and the same schedule. During the one-month study period all subjects were on a normocaloric diet evaluated every week by a dietetic record book. At the end, the mean body weight of the IG group was decreased by 5.26 ± 2.37% ($p < 0.0001$) and that of the placebo group by 1.32 ± 0.41% ($p < 0.02$). The difference observed between the IG and the placebo groups was significant ($p < 0.01$). The obese patients under *Irvingia gabonensis* treatment also had a significant decrease of total cholesterol, LDL-cholesterol, triglycerides, and an increase of HDL-cholesterol. On the other hand, the placebo group did not manifest any changes in blood lipid components (Iwu, 2016). The male fertility enhancement of *Irvingia* has been evaluated in a study in which hormonal parameters of male guinea pigs were investigated and compared with that of Proviron using enzyme immuno assay method, which was done by reaction of antibody with serum testosterone and testosterone label, magnetic solid phase separation and color development step. The aqueous extract of the seeds (50-400 mg/kg) caused a statistically significance increase ($P<0.05$ ANOVA) of testosterone in male guinea pigs, from 2.70 (±0.26) ng/mL to 3.10 (±0.42) ng/mL on the 7th day and to 3.30 (±0.48) ng/mL on the 28thday of the administration of the extracts. It was reported that the highest increase was 3.30 (±0.48) ng/mL, being obtained after 28 days of treatment. These effects were similar to that of Proviron, which was 2.80 (±0.28) ng/mL and 3.00 (±0.41) ng/mL on the 7th and 28th day of treatment respectively (Obianime, 2010).

G.3.5 Pharmacodynamic properties

Numerous studies exist on the potential industrial application of African Bush mango in food, cosmetics and pharmaceutical products. Dika fat is used in pharmaceutical drug as micro encapsulation of Aspirin better protection against hydrolysis when compared with bee and carnauba wax. African mango seeds from studies contains high when compared to acacia and tragacanth in emulsion and suspension formulations. Dika nut mucilage is also used to improve tablet strength and drug-release properties in tablet formulations (Odeku *et al*., 2005).

G.3.6 Dyslipidaemia

The dyslipidaemia associated with obesity plays a major role in the development of atherosclerosis and cardiovascular disease (Howard *et al.,* 2003). The consumption of ground IG over a 4-week period brought about a 39.21% reduction of total cholesterol, a 44.9% decrease in triglycerides, and a 45.58% reduction in LDL cholesterol. These changes were accompanied by a 46.85% increase in HDL

cholesterol, resulting in a decrease in the atherogenicity index of overweight individuals (Ngondi *et al.,* 2005). Similar findings were reported by Ngondi *et al.,* 2009) for the use of the IGOB131 in overweight and obese humans over a 10-week period, in which the plasma total cholesterol levels dropped significantly. This was accompanied by a significant drop in LDL cholesterol levels.

G.3.7 Antioxidant

Matsinkou (2010) has effectively used the high content of polyphenols in the pulp of IG to reduce oxidative stress in diabetes, as determined by a significant reduction of plasma malondialdehyde (MDA) levels.

G.4 Safety data

G.4.1 Ethnic use safety

G.4.2 Single dose toxicity Toxicology:

Acute toxicity studies documented no deaths within 24 hours or 7days after administration of African bush mango methanol extracts in rats (Raji *et al*., 2001).

G.4.3 Mutagenic potential

G.4.4 Carcinogenicity

G.5 Key (proposed) usage

G.5.1 Therapeutic indications

G.5.2 Dosage/posology

Clinical studies used dosage regimens of 150 mg of African bush mango seed extract 30 minutes before lunch and dinner or 1,050? mg 3 times daily 30 minutes before meals with a glass of warm water. Powders, liquids and capsules are available from commercial manufacturers, with most common dosage regimens consisting of 150 mg of African bush mango twice a day with food. (Temitope, 2016)

G.5.3 Contraindications

Irvingia gabonensis is possibly safe for adults when a crude seed extract is taken for up to 4 weeks, or when a specific standardized seed extract called IGOB131 is used for up to 10 weeks. The only side effects reported are flatulence, headaches, and sleep problems. Avoid use with known allergy or hypersensitivity to any of the components of African bush mango.

G.5.4 Special warnings and precautions for use

No information.

G.5.5 Interactions

Limited information is available regarding drug interactions. Because African bush mango delays stomach emptying, prescription medications should be co-administered with caution.

G.5.6 Pregnancy and lactation

There is not enough reliable information about the safety of taking *Irvingia gabonensis* if you are pregnant or breast feeding.

G.5.7 Paediatric use:

G.5.8 Adverse effects

Clinical studies enrolled a small number of patients, and mild side effects were documented. Adverse reactions included headache, dry mouth, Gastrointestinal complaints, sleep disturbance and flu-like symptoms.(Ref?)

G.5.9 Overdose

The major symptoms of overdose are hyperactivity, insomnia. Treatment should be supportive with generous amounts of fluid.

G.6 Evaluation of efficacy

G.7 Safety and interaction classification

G.8 Clinical Studies

G.9 Trade information

G.10 Regulatory information

British Pharmacopoeia 2012
WHO Monograph on Selected Medicinal Plants 1999
Nigerian Herbal Pharmacopoeia (2008)

G.11 Possible developments

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