Anti inflammatory and other effects of *Kigelia africana* extracts

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Presented on behalf of PhytoTrade Africa,
The Southern African Natural Products Trade Association

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Kigelia africana

About PhytoTrade Africa

• Helps African rural producers develop and market their natural products for export
• Non-profit trade association representing 55 members in the region
• Promotes sustainable production and certification
• Fair trade, contributing to the economic development of Southern African countries (Botswana, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, Zimbabwe)
• Natural products are collected in the wild by rural producers, and include:

  Cosmetic and personal care raw materials and ingredients, herbal extracts and botanical medicines, food supplements and nutritional ingredients, flavours and fragrances, health foods and drinks, industrial raw materials and ingredients.
## Folklore Uses on the skin

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>PART USED</th>
<th>INDICATION</th>
<th>EXTRACT/ FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>K. africana</td>
<td>Fruit</td>
<td>Anti bacterial Cures Acne</td>
<td>Fruit (ripe)</td>
</tr>
<tr>
<td>K. africana</td>
<td>Fruit powder</td>
<td>Wounds and ulcers; breast firming</td>
<td>Powder used as a dressing</td>
</tr>
<tr>
<td>K. africana</td>
<td>Fruit powder</td>
<td>Disinfectant</td>
<td>Powder used in solution</td>
</tr>
<tr>
<td>K. africana</td>
<td>Fruit powder</td>
<td>Eczema</td>
<td>Powder used as a dressing</td>
</tr>
<tr>
<td>K. africana</td>
<td>Fruit slices</td>
<td>Breast firming</td>
<td>Fruit (ripe)</td>
</tr>
</tbody>
</table>
Kigelia africana

Description

• African Sausage Tree - *Kigelia africana / pinnata*
• Member of the Bignoniaceae family – 650 species
• Widely distributed throughout sub-Saharan Africa
• Large, sausage-shaped fruit, 30-60 cm long, weighing up to 3kg per fruit
Kigelia africana
Kigelia africana

Iridoids

R = H minecoside
R = OCH₃ specioside
R = OH verminoside
Kigelia africana

Caffeic acid derivatives

- Caffeic acid
- Ferulic acid
- p-Coumaric acid

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Kigelia africana

Naphthoquinones

2-(1-hydroxyethyl)-2-acetyl-naphtho[2,3-b]furan-4,9-dione

Lapachol

Kigelinone
# Kigelia africana

**Skin Anti Cancer activity**

I.C 50 values for *K. pinnata* against G361 melanoma cell line (Houghton 2000)

<table>
<thead>
<tr>
<th>Extract</th>
<th>I.C(_{50}) values (Ng/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit (active fraction)</td>
<td>1.2 ± 0.2</td>
</tr>
<tr>
<td>Stem Bark</td>
<td>2.1 ± 0.2</td>
</tr>
<tr>
<td>Betulinic Acid</td>
<td>3.2 ± 0.2</td>
</tr>
</tbody>
</table>
Kigelia africana
Skin Anti Cancer activity

Test Group Number of papillomas per mouse 15.8±0.4) (Azuine et al., 1997)

<table>
<thead>
<tr>
<th>Test Group</th>
<th>Number of papillomas per mouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzo(a)-pyrene</td>
<td>5.8±0.4</td>
</tr>
<tr>
<td>B(a)P + Fruit extract</td>
<td>1.4±0.2</td>
</tr>
</tbody>
</table>
A number of extracts were prepared from Kigelia fruits:

- The fruits were air dried to constant weight
- Ethanol based extracts of the pulp
Kigelia africana

Phytotrade studies

CO2 extracts of the separated pulp and seeds

Extraction yields:
Seeds: 15%
Pulp: 5%

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<table>
<thead>
<tr>
<th>Carbon length/ Degree of unsaturation</th>
<th>Compound</th>
<th>Lit</th>
<th>Lit</th>
<th>Lit</th>
<th>CO₂ EXTRACT SEED</th>
<th>CO₂ EXTRACT PULP</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 : 0</td>
<td>Palmitic acid (Hexadecanoic acid)</td>
<td>7.0</td>
<td>25.40</td>
<td>7.80</td>
<td>6.80</td>
<td>8.70</td>
</tr>
<tr>
<td>18 : 0</td>
<td>Stearic acid (Octadecanoic acid)</td>
<td>1.0</td>
<td>0.90</td>
<td>6.20</td>
<td>3.80</td>
<td>3.0</td>
</tr>
<tr>
<td>18 : 1</td>
<td>Oleic acid (9 – Octadecenoic acid)</td>
<td>10.0</td>
<td>8.90</td>
<td>26.60</td>
<td>13.80</td>
<td>13.50</td>
</tr>
<tr>
<td>18 : 2</td>
<td>Linoleic acid (9, 12 – Octadecanoic acid)</td>
<td>25.0</td>
<td>42.0</td>
<td>15.0</td>
<td>16.27</td>
<td>16.99</td>
</tr>
<tr>
<td>18 : 3</td>
<td>α – Linoleic acid (9, 12, 15 – Octadecatrienoic acid)</td>
<td>57.0</td>
<td>--</td>
<td>44.10</td>
<td>52.97</td>
<td>51.48</td>
</tr>
</tbody>
</table>
### Identified Long-Chain Alcohols and Sterols

<table>
<thead>
<tr>
<th>Component</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Tetracosanol</td>
<td>0.019</td>
</tr>
<tr>
<td>1 – Hexacosanol</td>
<td>0.018</td>
</tr>
<tr>
<td>1 – Octacosanol</td>
<td>0.084</td>
</tr>
<tr>
<td>1 – Triacontanol</td>
<td>0.071</td>
</tr>
<tr>
<td><strong>Total Long-Chain Alcohols (%)</strong></td>
<td><strong>0.19</strong></td>
</tr>
<tr>
<td>Campesterol*</td>
<td>0.150</td>
</tr>
<tr>
<td>Stigmasterol</td>
<td>0.586</td>
</tr>
<tr>
<td>(b)-Sitosterol + Stigmastanol*</td>
<td>2.207</td>
</tr>
<tr>
<td><strong>Total Sterols (%)</strong></td>
<td><strong>2.94</strong></td>
</tr>
</tbody>
</table>

*Campesterol, and Stigmastanol new compounds identified in Kigelia*
Kigelia is being developed by PhytoTrade Africa for its potential use as an ingredient in:

- Pharmaceutical
- Nutraceutical
- Cosmeceutical products
Further biological studies undertaken by PhytoTrade Africa

• Anti Cancer effects
• Anti Oxidant effects
• Anti Inflammatory effects

Kigelia africana
Antioxidant studies conducted by PhytoTrade Africa

• *FRAPP* assay – ethanolic extracts showed comparable activity to grape juice
• *ABTS antioxidant assay* – Potent antioxidant effects due to caffeic acid derivatives and compounds unique to *Kigelia*
Further biological studies undertaken by PhytoTrade Africa

*Anti inflammatory activity* – Potent activity in a number of assays
Anti Inflammatory studies

Two different anti inflammatory assays:

• *Inhibition of “oxidative burst” on human neutrophils*

• *Inhibition of Cyclooxygenase*
Anti inflammatory assay “Oxidative burst” – Reduction of highly – water soluble terazolium salt WST-1 in the presence of activated neutrophils

Studies were undertaken by HEJ RESEARCH INSTITUTE OF CHEMISTRY, UNIVERSITY OF KARACHI
Human neutrophils were obtained from healthy human volunteers.

Kigelia africana extracts were tested against a control (buffer, neutrophils and WST-1) and against Indomethacin.

Absorbance measured at 450nm. IC50 values were expressed as % inhibition of superoxide produced.
Extract #2 was most active tested. It showed highest activity at 500mg/ml conc.

<table>
<thead>
<tr>
<th>Serial No</th>
<th>Compound Code</th>
<th>% Inhibition 500µg/mL</th>
<th>IC$_{50}$±Sem</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>H.S.I/P/2-infl</td>
<td>93.94</td>
<td>232.09±25.50</td>
</tr>
<tr>
<td>5</td>
<td>Indomethacine</td>
<td>44.57 (200µg/mL)</td>
<td>271.21±5.90</td>
</tr>
</tbody>
</table>
• COX converts Arachadonic acid to Prostaglandins (pain mediators)
• Inhibition of prostaglandin production produces pain relief
• Two isoforms of Cyclooxygenase:
  COX–1
  COX-2
Kigelia africana
Anti inflammatory studies:
Inhibition of Cyclooxygenase

Arachidonic acid (C 20:4)

COX - 1

Prostaglandins

COX - 2

Allergies, inflammation, gastric damage

Inflammation by injury, localised pain relief

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Preference for selective COX-2 inhibitors

- COX-1 present in all tissues
- Inhibition of COX-1 effects gastric secretions and can lead to ulceration of the stomach
- COX-2 is induced at sites of inflammation
Synthetic COX-2 inhibitors have been shown to be clinically relevant e.g.:

**Celecoxib (Pfizer)**

**Rofecoxib (Merck & Co.)**
Kigelia africana

Anti inflammatory effects:
Inhibition of Cyclooxygenase

<table>
<thead>
<tr>
<th>Species &amp; Parts /Synthetic Used</th>
<th>Extract</th>
<th>COX-2 Activity (µg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kigelia africana, fruit²</td>
<td>chloroform/ethanol/water</td>
<td>IC₅₀ 0.8</td>
</tr>
<tr>
<td>Kigelia africana, fruit²</td>
<td>methanol/chloroform</td>
<td>IC₅₀ 0.8</td>
</tr>
<tr>
<td>Indomethacin²</td>
<td>--</td>
<td>IC₅₀ 32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Species Used</th>
<th>COX-2 Activity (µg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Kigelia africana</em></td>
<td>IC$_{50}$ 60</td>
</tr>
<tr>
<td><em>Arnica montana</em></td>
<td>IC$_{50}$ 110</td>
</tr>
<tr>
<td><em>Sanguinaria canadensis</em></td>
<td>IC$_{50}$ 50</td>
</tr>
<tr>
<td><em>Solanum dulcamara</em></td>
<td>IC$_{50}$ 150</td>
</tr>
<tr>
<td><em>Tinospora smilacina Benth</em></td>
<td>IC$_{50}$ 81.2</td>
</tr>
<tr>
<td><em>Tripterygium wilfordii Hook</em></td>
<td>IC$_{50}$ 125</td>
</tr>
<tr>
<td><em>Scutellaaria baicalensis</em></td>
<td>IC$_{50}$ 150</td>
</tr>
</tbody>
</table>
Kigelia africana

Anti inflammatory activity

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In Conclusion

• Kigelia fruits have strong folklore for use as an antibacterial, anti-inflammatory and anti-viral agents.

• PhytoTrade Africa have prepared a number of unique extracts of Kigelia fruits.

• These have been shown to display potent antioxidant and anti-inflammatory activity.

• These extracts can be ready formulated into a variety of food and dietary supplements for use as a unique Nutraceutical ingredient.
In Conclusion

PhytoTrade Africa is currently working with key extract manufacturers to produce effective and safe extracts for a range of possible applications.
In Conclusion

**Possible cosmeceutical and topical applications:**

**“After sun” skin lotion**

**Breast firming agent**

**“Anti aging” and anti oxidant effects on the skin**

**Reduction of skin irritation, soothing agent**

**Reducing reddening of the skin and inflammation**

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These extracts can be ready formulated for use as a unique cosmeceutical ingredient.

Kigelia water/ alcohol extracts are ideal for water based cosmetic products such as gels, lotion and water/oil emulsions and creams.

CO2 extracts are lipophilic and can be incorporated into oil based cosmetic formulations such as creams, lotions, oils.
The benefits of collaborating with PhytoTrade Africa

• Supply chain development and raw material sourcing
• Support for organic certification, sustainability and Fair Trade issues
• Documentary and bibliographic support
• Collaborative research and development
• Marketing tools – imagery and documentation
• Legitimate access to African biological resources, traditional knowledge and folklore

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Further research work in Phytochemistry

Phytopharmacognosy Internet Group

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