Importance and potential of bitter gourd in agriculture, nutrition and health

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International Nutrition
University of Giessen, Germany
Constituents of *M. charantia* according to Sofowora, 1982

<table>
<thead>
<tr>
<th>Plant part</th>
<th>Constituents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh immature fruit</td>
<td><em>0.035% charantin</em> – isolated in pure state as a neutral non-nitrogenous principle presenting the characters of <em>phytosterolines</em>;</td>
</tr>
<tr>
<td>Seeds</td>
<td>Contain 32-35% of a purgative fixed oil (stearic acid, oleic acid, linoleic, and α-eleostearic acid); albumin, globulin, glutelin, Vitamin B, carotene and α-amino butyric acid;</td>
</tr>
<tr>
<td>Dry plant</td>
<td><em>0.038% alkaloid</em> (unnamed); 8.35 μg/g total carotenoid pigments</td>
</tr>
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<tr>
<td>Leaves</td>
<td>Two acidic resins and momordicine (bitter substance), Vitamin C, carotenoids (depending on the sample); γ-aminobutyric acid</td>
</tr>
<tr>
<td>Roots</td>
<td>About 13% ash (major elements: silicon, calcium, phosphorus, strontium, copper, lead, zinc, sodium and iron)</td>
</tr>
<tr>
<td>Fruit</td>
<td>About 7% ash (major elements: see roots); no free pectic acid but soluble pectins; saponins, 5-hydroxytryptamine, alkaloid momordicine; 0.3% total alkaloid; steroidal glucosides</td>
</tr>
</tbody>
</table>


Bitter gourd salad
Position of 83 *Momordica* accessions
determined by the first two principal components
on the basis of 359 RAPD bands

Data source: CA Liu, AVRDC, unpublished

Origins of *Momordica* accessions in AVRDC
... much more to be learned from the horticulture experts in this conference

Importance and potential of bitter gourd in agriculture, nutrition and health
Oxidative stress and mean glucose levels


Momordica charantia whole fruit freeze-dried and milled

- extraction with ethyl acetate
  - lipid fraction
- rest
- extraction with methanol
  - methanol soluble fraction
- rest (not used)
- n-butanol/water
  - n-butanol layer
  - water layer
  - hydrophilic rest
  - saponin fraction

Diagram showing the extraction process of Momordica charantia.
animal trial

- four weeks old male dbdb mice
- 45 mice were randomly assigned to five groups of nine
- daily oral dose of 150 mg dry crude extract per kg bw for five weeks

<table>
<thead>
<tr>
<th></th>
<th>control</th>
<th>whole fruit</th>
<th>lipid fraction</th>
<th>saponin fraction</th>
<th>hydrophilic rest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(pure water)</td>
<td>(150 mg MC / kg bw *d)</td>
<td>(150 mg MCE / kg bw *d)</td>
<td>(150 mg MCE / kg bw *d)</td>
<td>(150 mg MCE / kg bw *d)</td>
</tr>
</tbody>
</table>

laboratory variables

- weekly control of feed intake and body weight gain
- glycated hemoglobin
- PTP 1B° activity in liver, skeletal muscle and adipose tissue
- PTP 1B° gene and protein expression via RT PCR and Western Blot in skeletal muscle
- adiponectin gene expression (adipose tissue)

°protein tyrosine phosphatase 1B;
weight gain

Without differences in feed intake

glycated hemoglobin (HbA$_{1C}$)

*p<0.05
adiponectin gene expression

![Bar chart showing adiponectin gene expression in adipose tissue as a percentage of control. Each bar represents a different fraction: control, whole fruit, lipid fraction, saponin fraction, and hydrophilic rest.]

native PTP 1B° activity

![Bar chart showing native PTP 1B° activity of skeletal muscle cytosol as a percentage of control. Each bar represents a different fraction: control, whole fruit, lipid fraction, saponin fraction, and hydrophilic rest.]

*protein tyrosine phosphatase 1B; measured with neutral pH buffer; **p<0.01, *p<0.05*
Antidiabetic effects of bitter gourd are related to ..

- conjugated fatty acids,
- saponins,
- substances found to inhibit the intestinal absorption of monosaccharides, or to enhance insulin secretion or to increase the insulin sensitivity of insulin-dependant tissues.
Discussion (2009)

... This is the first study to demonstrate effects of bitter gourd on PTP 1B-regulation as a mechanistic explanation for increased insulin sensitivity.

Klomann SD, Mueller AS, Pallauf J, Krawinkel MB.

Quantification of antidiabetic compounds - saponins

3.67% (on dry matter basis) saponin fraction in the whole fruit
0.40% (on dry matter basis) hemolytic saponins in whole fruits

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Background

Insulin resistance and type II diabetes mellitus are increasing worldwide - even in developing countries.

But: for patients in developing countries adequate medical treatment is often not available.

=> Vegetables with anti diabetic effects and their products are of great importance.
Diabetes Prevention
- Obesity prevention and management
- Regular physical activity
- Diet rich in fruits and vegetables
  → vegetables with antidiabetic activity

Diabetes Treatment
- Insulin and insulin-releasing agents
- Hypoglycaemic drugs
- Vegetables with antidiabetic activity

For centuries, Ayurveda has recommended the use of bitter melon (Momordica charantia) as a functional food to prevent and treat human health related issues.

Joint study on quality of diabetes control in Tanzania in collaboration with the diabetes clinic of the Kilimanjaro Christian Medical Centre, Moshi (2008)

Mark Swai, Patrick Lyaruu, Claudia Preis, Michael Krawinkel

No. of patients:
  total 96; 44 women, 52 men
Diagnosis:
  diabetes mellitus
  type I (7.3%) or type II (92.7%)
Age:
  13 to 95 years; mean 59.1 ±14.02 yrs
Study period:
  2006
Study site:
  Diabetes Clinic, Kilimanjaro Christian Medical Center, Moshi, Tansania
The major diabetic complications

Disease management in Tanzania (n=96)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of Patients</th>
</tr>
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<tbody>
<tr>
<td>Insulin</td>
<td>39</td>
</tr>
<tr>
<td>Oral antidiabetic drugs</td>
<td>50</td>
</tr>
<tr>
<td>Diet</td>
<td>6</td>
</tr>
</tbody>
</table>

![Graph showing HbA1c levels and number of patients](image)
HbA1c and diabetic retinopathy

AIDS and Diabetes mellitus

Access to adequate care is life-saving
- diet will play a major role

Source: www.unaids.org – The status of the global epidemic Nov03;
WHO/IDF, Diabetes Action now, 2004
... In this study, we have initially used human prostate cancer cells to assess the efficacy of bitter melon extract (BME) as an anticancer agent.

Pan WL, Wong JH, Fang EF, Chan YS, Ng TB, Cheung RC

... observations indicate the potential utility of α-momorcharin, isolated from seeds of the bitter gourd Momordica charantia, for prophylaxis and therapy of nasopharyngeal carcinoma cells.’