

Ethnomedicinal uses of *Momordica charantia* (Cucurbitaceae) in Togo and relation to its phytochemistry and biological activity

Nadine Beloin^a, Messanvi Gbeassor^b, Koffi Akpagana^b, Jim Hudson^c, Komlan de Soussa^b, Kossi Koumaglo^b, J. Thor Arnason^{a,*}

^a *Biology Department, University of Ottawa, Ottawa, Ont., Canada K1N 6N5*

^b *Faculté des Sciences, Université de Lomé, Lomé, Togo*

^c *Department of Pathology and Laboratory Medicine, University of British Columbia, Vancouver, BC, Canada V6T 1Z4*

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Abstract

Investigation of the traditional uses of *Momordica charantia* (Cucurbitaceae) in Togo (West Africa) showed that it is one of the most important local medicinal plants both for ritual and ethnomedical practices. There was a high degree of consensus (>50%) for use in the treatment of gastrointestinal and viral disease among 47 groups of village informants in the general population, while 19 traditional healers reported a larger and broader set of uses. The use by informants in Gaur and Kwa language groups was not significantly different. Lyophilized *Momordica charantia* extracts prepared from accessions collected in Togo showed high antiviral activity (<5 µg/ml) against Sindbis and Herpes simplex type 1 viruses and anthelmintic activity against *Caenorhabditis elegans* at 500 µg/ml. Presence in the leaves of the triterpene glycosides momordicins I and II follows biological activity of the plant extracts. However, momordicins were found to be anthelmintic but not antiviral. Traditional healers collected plants in dry areas where momordicin content is greater.

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1. Introduction

The pantropical herbaceous vine *Momordica charantia* (Cucurbitaceae) is used in a traditional medicine wherever it is found. The bitter melon or bitter gourd, as it is called in English speaking countries, is often used to treat diabetes (Halberstein and Saunders, 1978; Mossa, 1985; Zhang, 1992; Arvigo and Balick, 1993). For this purpose, fruits are used in Asia (Zhang, 1992), while the above ground part is used by the Maya in Belize (Arnason et al., 1981; Arvigo and Balick, 1993). Leaves, fruits and roots are also used to treat fevers (Ayensu, 1978; Halberstein and Saunders, 1978; Singh, 1986; Girón et al., 1991). They have also been used in reproductive health as an abortifacient, birth control agent, or to treat

painful menstruation and to facilitate childbirth (Kerharo and Adam, 1974; West et al., 1981; Burkill, 1985; Mossa, 1985).

While the ethnobotany of the plant in India and the Caribbean has been well documented (Chakravarty, 1959; Morton, 1966; Wong, 1976; Halberstein and Saunders, 1978; Girón et al. 1991), the distinct traditional use of *Momordica charantia* in West Africa is less known.

During a Togolese-Canadian medicinal plant survey, our working group identified a list of 25 priority plants, among which *Momordica charantia* was prominent for historical and ritual connotation as well as practical curative uses. The study area, Togo, is a small rectangular-shaped country stretching from the humid Gulf of Guinea to the dry savannah of Burkina Faso. Despite its small area, this country is very diverse, both ecologically and culturally. Five ecological zones cross the country in latitudinal bands (Ern, 1979). The different ethnic populations are distributed in a similar way. More than 30

* Corresponding author. Tel.: +1 613 562 5718; fax: +1 613 562 5486.

E-mail address: jarnason@science.uottawa.ca (J.T. Arnason).

ethnic populations are present in Togo, but it is possible to group them in three linguistic/ethnic groups which have very different and distinct views and ways of living, including their use of medicinal plants (Cornevin, 1969).

The first objective of the study was to document the traditional medicinal use of *Momordica charantia* in Togo. In particular, we investigated whether there was a similar consensus for use of this plant between the two major linguistic/ethnic groups in the country. We also investigated whether there was a similarity between the medicinal traditions of the general population for use of this plant and the more specialized knowledge of traditional healers. The second objective was to investigate several biological activities which are relevant to the traditional uses of *Momordica charantia*, using West African accessions in order to determine if uses were ritually or pharmacologically based. Finally we examined whether harvesting practices reflect a traditional knowledge on the chemical variation of the species.

2. Methods

2.1. Ethnobotanical methods

Several collecting trips were undertaken in all regions of Togo between July 1996 and March 1997. Interviews were conducted informally with village inhabitants present on site of collection of *Momordica charantia* (each 'gathering of people' is considered a 'group'). Questions were directed to vernacular names and uses of *Momordica charantia*. Questions which could be answered yes or no were avoided as much as possible (Martin, 1995). Following the completion of field trips (54 plants and 47 groups interviewed), uses mentioned by informants were grouped into seven categories: (1) gastrointestinal problems (stomach ache, vomiting, ulcers and intestinal worms, diarrhea, colic, dysentery, laxative and purgative); (2) viral diseases (chickenpox and measles); (3) skin afflictions (sores, ulcers, burns, cut, rashes, hives and scabies); (4) malaria; (5) gynecology (birth, abortion and dysmenorrhoea); (6) fever; and (7) food.

In addition, interviews with 19 traditional healers were undertaken by appointment at the place where they practice medicine. A larger number of healers from Southern Togo as compared to Northern Togo, were represented in this group. These interviews were more detailed than the ones with groups of villagers. In addition, they covered more precisely medicinal and medico-magical uses, and the preparation of the plant and conditions of harvest (Croom, 1983; Adjanohoun et al., 1989). A data report form was prepared to this effect and filled out immediately after each interviews, but interviews were conducted informally to obtain spontaneous responses (Beloin, 1998). The interviews were conducted in French by N. Beloin and use of a translator was necessary in some cases for native speakers. All these activities followed an informed consent protocol that was formally approved by the University of Ottawa ethics committee and

the Faculté des Sciences, Université du Bénin à Lomé (now Université de Lomé), prior to the collection of data.

2.2. Plant collections and extraction

Plants of *Momordica charantia* were collected in many localities throughout Togo in the five major ecozones of the country (Ern, 1979). These latitudinal zones are from north to south: Zone 1 Sudanese savannah; Zone 2 savannah with patchy forests; Zone 3 highland of Guinean savannah; Zone 4 dry tropical forest; and Zone 5 coastal region or humid savannah. A plant collection permit was obtained from the appropriate government authority in Togo. Fresh leaves and stems (50.0 g) were weighed directly on site and kept into 125 ml of 95% ethanol. Voucher specimens were collected and deposited in the herbarium at Agriculture and Agrifood Canada and at the herbarium of the University of the Ottawa (accessions nos. 19201–1949). Ethanolic extracts were filtered and vacuum-evaporated at 40 °C, and residual water removed by freeze drying. Plant material left was completely dried at 70 °C and weighed. Freeze-dried extracts were accurately weighed, dissolved in 1:1 acetonitrile:MeOH and filtered through a 0.45 µm PTFE syringe filter for further analyses.

HPLC analyses were performed on *Momordica charantia* extracts with emphasis on momordicins I and II contents. The system was a Beckman HPLC with a Lichrospher RP-18e column (125 mm × 4 mm, 3 µm) fitted with a Lichrospher RP-18e precolumn (4 mm × 4 mm, 5 µm). The mobile phase consisted of water (A) and MeCN (B) with a flow rate of 1.5 ml/min. The momordicins were eluted with a gradient of 30% B changing to 50% B in 10 min, 50% B changing to 80% B in 5 min, held at 80% for 5 min, recycled to 30% B in 1 min and re-equilibrated for 9 min. Detection was achieved at 205 nm. Momordicin standards were obtained from Dr. H. Okabe (Fukuoka University) and Mrs. F. Yasui (National Institute of Sericultural and Entomological Service), Japan.

2.3. Antiviral bioassays

The technique used is a modified version of that described in detail in Hudson et al. (2000). Briefly, Vero cells were cultured in standard medium (Dulbecco modified Eagle medium, with 5% (v/v) fetal bovine serum) in a 96-well plate, 0.1 ml per well. The lyophilized plant extracts were dissolved in ethanol (100 mg/ml) and diluted 100:1 in medium, sterilized by filtration through a 0.2 µm filter and added in duplicate to the 96-well microplates containing the Vero cells, which were incubated for 1 h at 37 °C. Herpes simplex virus (HSV-1) or Sindbis virus (SINV) were added to each well in a 0.1 ml aliquot containing 100 pfu. The cultures were immediately exposed to a combination of UVA and visible light for 30 min (total radiation dose 4 kW/m²), following which they were returned to the incubator at 37 °C. The procedure was repeated four times for HSV-1, three times for SINV and two times for both viruses maintained in the dark. The controls

included Vero cells without virus, Vero cells with virus without extract but treated with solvent, and infected Vero cells kept in the dark. In addition to momordicins I and II, five extracts of *Momordica charantia* were tested, each coming from a different ecological zone of Togo.

2.4. Anthelmintic assays

Anthelmintic activity of *Momordica charantia* extracts was tested against *Caenorhabditis elegans* due to its low biohazard. The variety Bristol, strain N2, was supplied by the *Caenorhabditis* Genetics Center (University of Minnesota, St. Paul, MN). The nematodes were cultured aseptically in Nematode Growth Medium (NGM) agar, inoculated with *Escherichia coli* (strain OP50, uracil auxotroph) as described by Lewis and Flemings (1995).

The nematode bioassay is a modified version developed by Schaeffer and Haines (1989). Eppendorf tubes were filled with M9 medium (96–99 μ l). Plant extracts dissolved in 60% ethanol were added to obtain a volume of 100 μ l containing no more than 4% alcohol. Adult nematodes were rinsed from Petri dishes with M9 medium, centrifuged at $500 \times g$ for 1 min and resuspended in M9. Aliquots of 100 μ l containing 20–50 nematodes were added to the Eppendorf tubes, bringing the volume to 200 μ l. After 24 h incubation at 23 °C, the motility of the nematodes was examined under a dissecting microscope. The lethal concentration for 50% mortality was determined from geometric concentrations. The LC₅₀'s were obtained by linear regression of the plot of log mortality divided by survival versus log concentration. Levamisole, a commercial nematicide with tetramisol as active ingredient, was the positive control (Perrett and Whitfield, 1995).

2.5. Climatic variables

The Meteorological Service of Togo in Lomé provided the climatological data for monthly and annual precipitation from various stations around the country (1982–1996). These data were necessary to evaluate the dryness of areas of harvest used in Table 5.

3. Results

3.1. Popular uses of *Momordica charantia* in Togo

Among the 47 groups of village informants in the general population interviewed, the majority (25 groups) indicated that *Momordica charantia* was used against gastrointestinal problems (Table 1). Almost as many groups indicated that the plant was used as a remedy against chickenpox and measles in children. Some mentioned 'smallpox' but it is difficult to interpret this statement as the disease has been eradicated. It is possible that respondents were making allusion to simian orthopoxvirus (monkeypox), occasionally encountered in West African forest zones (WHO, 1997). Skin problems were men-

tioned by 21% of informant groups, and malaria, gynecological aid, fevers and food were mentioned at a lower frequency (<20%). One mention was made of the use of the plant in water to soak seeds before sowing in order to ward off insect and fungal pests.

Respondents generally used the herbaceous vines (stem and leaf) which are plunged in water (1 handful/pot = approximately 100 g/l) for several hours, then drunk or used for bathing the skin, along with the intertwined vines used as a sponge when necessary. The seed is rarely used except for gynecological purposes (delivery, dysmenorrhoea, abortion) in which case they are applied locally. The plant is said to be a 'volunteer' (not planted) but is often maintained by watering it with grey water from the kitchen, cleaning or shower. In fact, most collection sites were in close proximity to villages (78%).

Informant groups were classified into the two main linguistic/ethnic families of Togo: Gour (or voltaic, including Gurma, Tem and Kabyè) and Kwa (or eburneo-dahomey, including Adja, Ewe, Mina and Ife-Ana) (Cornevin, 1969; Table 1). For each of the seven general uses of *Momordica charantia*, a *t* test between the two language families was performed. None showed a significant difference, meaning that the two language families were using the plant similarly for all uses mentioned ($p > 0.05$ for each use). The mean (S.E.) number of uses per group of informants for the Gour respondents was 2.10 (0.23) and 1.65 (0.21) for the Kwa language family. However, these means were not significantly different (*t* test, d.f. = 42, $p = 0.151$).

3.2. Uses of *Momordica charantia* by traditional healers in Togo

The same use categories as for the general population were used to describe the traditional healers' responses, except for the use for diabetes mentioned by 33% of the healers but not by the general population (Table 1). The percentage of mention for most categories is significantly similar when comparing healers with general population (*Z* test: $p > 0.05$ for gastrointestinal, childhood viral diseases, skin problems, malaria and food uses). However, gynecological aid, fevers, and diabetes were three uses much more commonly cited by the healers (*Z* test: $p < 0.01$). Healers mentioned a mean number of 4.1 uses (S.E. = 0.45), which is significantly higher ($t = -4.772$, d.f. = 62, $p < 0.001$) than the general population. There was a positive correlation between the number of uses made and the age of the healers, although the relation was a marginally significant trend (Pearson $r = 0.45$, $p = 0.068$, $n = 17$). Healers used the entire plant, sometimes including fruits if present, but seldom the seeds, which 47% of the healers described as toxic. Many healers also indicated that the plant has powerful medico-spiritual properties, providing protection against curses, diseases, evil spirits, spells and madness. It is also claimed to aid in obtaining favors. It is claimed to be a purifying plant that is used before the manipulation of sacred objects.

Table 1

Utilization of *Momordica charantia* in Togo by Gour (or 'voltaic') language groups and Kwa (or 'eburneo-dahomey') language groups in the general population in comparison to utilization by Togolese traditional healers

Uses described	Gour, <i>n</i> = 26 ^a (%)	Kwa, <i>n</i> = 18 ^a (%)	General population ^b (Gour + Kwa), <i>n</i> = 44 ^a (%)	Traditional healers ^c , <i>n</i> = 19 ^a (%)
Gastrointestinal	72	46	53	61
Childhood viral diseases	61	46	51	67
Skin problems	30	15	21	17
Malaria	22	12	17	28
Gynecological aid	17	12	13	61
Fevers	11	12	11	39
Diabetes	0	0	0	33
Food	6	15	11	11

The percentage of informant groups (as defined in Section 2) reporting each use is given.

^a Number of group interviewed or to number of individual healer interviewed.

^b General population combines Gour and Kwa language groups.

^c Traditional healers are from both language groups.

Many original details concerning the ritual and historical aspects of *Momordica charantia* were recounted by some healers from Southern Togo. The plant is used in traditional ceremonies linking the living to the ancestors, particularly among the Guin tribe of coastal Togo. The ancestors of the Guin lived on the coast of Ghana near what is today the area of Elabadi in Accra. In mid-1600, they fled intertribal warfare fueled by the slave trade and moved to the east into what is now Togo (Cornevin, 1969). According to oral tradition, they wore a necklace of *Momordica* vines which repelled their enemies and allowed the tribe to journey in safety to their new home at Glidji-Kpodji on the northern side of Lake Togo. The plant is considered a powerful charm to this day and is worn as a necklace, wrist or ankle bracelet or crown at traditional ceremonies. Its name in Mina, the dialect language of the Guin, is 'guinsika' (gold of the Guin) or 'guingbe' (plant of the Guin). The plant is widely used in traditional ceremonies, including the famous consultation of the oracle named Epe-Ekpe or Ekpeosso, during which a sacred stone is uncovered to predict the fortunes of the coming year (Piroux, 1977). The king of the Guin, which is also the fetish priest of the sacred forest of Glidji-Kpodji, and his male attendants (vodussi) at the ceremony wear *Momordica* vine for its purification properties. The ritual ceremonial importance of the plant is accompanied by its considerable reputation as a medicinal plant for the treatment of disease.

The interviews indicated many similar characteristics among the traditional healers. Many are well educated with high school, college and university degrees. A few were trained as conventional MD's but also conserved their status as traditional healers, whose craft they learned as long-term apprentices from older traditional healers, often family members. Most are full time practitioners. In larger towns and cities in Togo, the traditional healers usually have an office with a waiting room, some treatment rooms, as well as a pharmacy for the preparation of plant-derived drugs. In the villages, visits by patients occur at the healers home, usually during a fixed schedule of consultation hours. All are well recognized in their communities. Some interviewed healers are in addition fetishers or priests of the vodun religion.

Traditional healers often have specific cultivation or collection areas and maintain particular criteria for harvest. In the interviews, there were questions regarding their harvest criteria (Table 2). Although the questions were aimed specifically at our plant of interest, we found out that all healers responses' generally concerned all kind of medicinal plants. There was clearly a preference for morning harvest, for plants collected away from villages and for dry sites. There was no clear preference for plant maturity, or exposure to light, or for soil conditions.

3.3. Bioassays

Lyophilized extracts of *Momordica charantia* plants were highly antiviral against HSV-1 and SINV viruses (Table 3). The extracts were marginally more antiviral in light than dark for HSV-1 (*t* test, *t* = -1.906, d.f. = 28, *p* = 0.067). No dark antiviral activity against SINV was detected at the

Table 2

Harvest criteria used by 19 Togolese traditional healers interviewed about their method of collecting medicinal plants

Harvest criteria	Category	No. of mentions ^a
Time of harvest during the day	Morning	9
	Midday	2
	Evening	4
Habitat	Field	3
	Forest	5
	Far from habitations	7
Humidity at site	Dry	9
	Wet	3
Phenological stage	Flowering plants	1
	Fruiting plants	2
Soil	Rocky	2
	Clay soil	2
	Black earth	1
Light	Partial shade	2
	Full sun	2

^a Number of healers who described a particular harvest criteria while identifying the category preferred.

Table 3
Antiviral activity of five *Momordica charantia* lyophilized extracts against HSV-1 and SINV viruses, with or without exposure to light

Ecological zone of harvest ^a	HSV-1 light MIC ^b (μg/ml)		HSV-1 dark MIC (μg/ml)		SINV light MIC (μg/ml)		SINV dark MIC (μg/ml)
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean
1	4	4	12	0	3	2	>175
2	3	3	51	60	2	2	>175
3	9	15	10	3	5	4	>175
4	2	1	35	38	2	2	>175
5	113	101	438	88	40	20	>175

^a The five extracts come from plants collected in five different ecological zones in Togo. These zones go from north to south. Zone 1: Sudanese savannah; Zone 2: savannah with patchy forests; Zone 3: highland of Guinean savannah; Zone 4: dry tropical forest; Zone 5: coastal region or humid savannah (Ern, 1979).

^b Minimum concentration required to inactivate 100 plaque-forming units of virus.

concentrations tested, but the extracts were active against the same virus in light conditions. The main bitter principles from *Momordica* leaves, the triterpenoid glycosides momordicins I and II, presented no antiviral activity against the two types of virus up to 250 μg/ml. Above this concentration, they were cytotoxic to the host cells.

The five extracts tested were from the five ecological regions of Togo. The extract from a plant collected in the humid coastal region (Zone 5) was significantly less active than those from Zones 1 to 4 under light conditions for HSV-1 (ANOVA: $F = 4.48$, d.f. = 4, $p = 0.014$) and SINV (ANOVA: $F = 9.26$, d.f. = 4, $p = 0.002$). Testing more accessions from each of the ecological zones would clarify this chemical ecology tendency.

Anthelmintic activity against *Caenorhabditis elegans* was confirmed with three extracts of *Momordica charantia* plants collected in three different regions of Togo (Table 4). The collection from the coastal area was again the least active, while anthelmintic activity was greater in the two northern sites (Zones 1 and 2). All three plant extracts were about 20–50 times less active than Levamisole. Momordicins I and II were tested for anthelmintic activity in replicated trials ($n = 10$ for each compound) at 20 μg/ml, the approximate LC₅₀ of Levamisole, for comparative purposes (Table 4). Momordicin I caused a mean (S.E.) mortality of 19.0% (4.3) and momordicin II caused 22.5% (3.3) mortality to the nematodes. This is approximately half the activity level of the positive control, Levamisole. LC₅₀'s were not attempted due to insufficient isolated compounds. These results clearly show that momordicins are important active nematicides in the extracts. Although their concentration in the extracts (Table 4) does not explain all of the activity of the crude extract against nema-

todes, the concentration of momordicins (I and II) increased with the increasing toxicity of the extracts, suggesting that they are marker phytochemicals for nematicidal activity.

3.4. Environmental effects on momordicin content

In order to determine if the harvesting criteria mentioned by the healers may be related to the variation in phytochemistry in the species, the concentration (dry weight basis) of the phytochemical marker compounds, momordicins I and II found in *Momordica charantia* extracts, was studied in relation to environmental factors where the plants were collected (Table 5). Time of harvest during the day had no effect on individual or total momordicin contents. Precipitation data at each collection site were evaluated using local climatological stations. The mean annual precipitation was significantly and negatively correlated with momordicin I, but not with momordicin II or the total momordicins content. Another way to evaluate the dryness/humidity of sites is to look at seasonal precipitation variability. It is defined as the change in mean precipitation from month to month over several years. The seasonal precipitation variability was significantly correlated with total momordicins. It was also positively correlated with momordicin I or II alone, but not significantly. In other words, plants growing in regions where the monthly precipitation varies greatly during the year have higher concentration of momordicins. These results are in relation to the fact that the water content of plants at collection was significantly negatively correlated with the individual and total momordicins (Table 5). Using a *t* test to discriminate between harvest near human habitation, or away from houses, it was found that the total momordicin concentration of plants growing near

Table 4
Anthelmintic activity (LC₅₀) and momordicin content (w/dry wt) of three *Momordica charantia* lyophilized extracts against the nematodes *Caenorhabditis elegans*

Ecological zone of harvest ^a	LC ₅₀ (μg/ml)	<i>n</i>	Momordicin I (μg/g)	Momordicin II (μg/g)
1	473	36	0	197
2	538	53	56	63
5	997	52	81	11
Levamisole ^b	17	17	–	–

Note. All regressions for LC₅₀ determinations were significant at $p < 0.001$, except Levamisole that was significant at $p = 0.042$.

^a See Table 3.

^b Positive control.

Table 5

Pearson correlation coefficient (r) between the concentration of momordicins (w/dry w) in *Momordica charantia* lyophilized extracts and the local climatic factors at the collection sites, as well as relation to plant water content

Environmental factor	Momordicin I (r)	Momordicin II (r)	Total momordicins (r)	No. of plant harvested
Time of harvest during the day	0.047	−0.020	−0.001	54
Mean annual precipitation	−0.285*	0.252	−0.025	54
Coefficient of variation monthly precipitation	0.262	0.152	0.358**	53
% Water content in plants	−0.411**	−0.401**	−0.484***	54

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

houses was significantly higher ($t = 2.078$, $p = 0.043$, d.f. = 52; Table 2).

4. Discussion and conclusion

The present study indicates a high level of general knowledge among residents of Togo regarding the use of traditional medicines in general, and *Momordica charantia* in particular. The most important uses of this plant were gastrointestinal and viral infections in children, uses that were widely cited by more than 50% of informant groups within the general population. The use of the plant is so widespread that consensus on its use is conserved across linguistic and cultural divisions between the Gour and Kwa language groups.

There was also consensus between the results of the general population and those of the traditional healers concerning utilization of *Momordica charantia* in gastrointestinal and antiviral uses, but overall the healers have a broader range of uses for the plant. The additional use of the plant in gynecology and to induce abortion reported by the healers may be due to their regular use of the plants or the fact that the professional healers are less reluctant to talk about these problems which they deal with regularly, compared to the general population. In addition, the traditional healers reported a higher use of the plants to treat fever caused by infections and diabetes. The healers' use for diabetes may represent their consultation of published literature and international reports of the use of the plant for this disease. The low use as an antimalarial may be directly related to its low efficacy (Gbeassor et al., 1989).

Comparison of the use in Togo with traditional uses elsewhere in the world obtained from the NAPRALERT (UIC) ethnobotanical database, clearly show that the tradition in Togo is distinct (Beloin, 1998). Although gastrointestinal problems are important on a worldwide basis, the prominent antiviral uses in Togo is rarely mentioned on a world scale for this species.

The strong activity of *Momordica charantia* reported in this study against HSV-1 supports the antiviral uses of the plant against viral diseases caused by herpes viruses (membrane-bound double stranded DNA viruses), including varicella or 'chickenpox' (Roizman, 1996). The activity against Sindbis virus supports uses against the Togaviridae viruses and related viruses (membrane-bound single stranded RNA viruses) (Schlesinger and Schlesinger, 1996). These re-

sults support the use against a spectrum of viral diseases. The topical use of the plant for measles and chickenpox may also be related to a direct relief of skin irritation. The antiviral activity of *Momordica charantia* is one of the most potent among a number of West African plants that have been screened by us (Anani et al., 2000; Hudson et al., 2000). Clearly the active ingredient is not momordicin I or II, and further work is warranted, especially on biologically active proteins. The enhancement or dependence of antiviral activity on light indicates that one or more photosensitizers are involved, a common finding in studies on antiviral plant extracts (Hudson and Towers, 1999).

The anthelmintic activity of the leaves of *Momordica charantia* supports its use against gastrointestinal problems in West Africa commonly caused by nematode infections. Pathogenic species were not directly tested because of their biohazard and the culture conditions required. The work presented here suggests that anthelmintic activity is high and that triterpene glycosides of bitter melon like momordicins I and II are very active nematicidal principles. It is probable that the antibacterial activity of *Momordica charantia* reported in the literature (over 85 reports in the NAPRALERT database in 1995) also contributes positively to gastrointestinal treatments. Many viruses have also been implicated in gastrointestinal diseases (Melnick, 1996).

A criterion for collecting plants by traditional healers is dry conditions of harvesting area. It appears to provide plants with higher levels of the marker phytochemicals, momordicins I and II. While phytochemical markers associated with antiviral activity are still to be determined, the results shows a tendency that both anthelmintic and antiviral activities are lower in accessions from coastal, more humid region, and are higher in plants collected in the drier north of the country.

5. Conclusion

The importance of *Momordica charantia* in ritual use in Togo reinforces its importance as a medicinal plant for which there is strong consensus for use in treatment of viral infections and gastrointestinal conditions. The bioassay data provided here suggest that these uses have a pharmacological basis.

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