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RESEARCH ARTICLE

ETHNOPHARMACOLOGICAL STUDY OF PLANTS USED IN THE TREATMENT OF PROSTATE CANCER AND BENIGN PROSTATIC HYPERPLASIA IN TOGO: THE VALUE OF *ANNONA MURICATA* (SOURSOP)

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ABSTRACT

Background: Prostate cancer and benign prostatic hyperplasia (BPH) are common reasons for consultation in Togo, where prostate cancer is still diagnosed at an advanced stage. Leaves of *Annona muricata* L. (soursop) are among the most frequently cited traditional remedies for these conditions, yet their local uses have never been systematically documented. **Objective:** To document the knowledge, practices and perceptions of traditional medicine stakeholders regarding *A. muricata* in the management of prostatic disorders. **Methods:** A cross-sectional ethnopharmacological survey was conducted from 31 December 2025 to 25 January 2026 among 84 respondents (53 medicinal plant sellers, 18 traditional healers, 8 patients or former patients, 3 caregivers and 2 others) in Greater Lomé (Golfe and Agoè-Nyivé prefectures), using a semi-structured questionnaire digitised in KoboToolbox. Analysis combined descriptive statistics, ethnobotanical indices (relative frequency of citation, fidelity level), χ^2 , Fisher's exact, Mann-Whitney and Kruskal-Wallis tests, Spearman correlation and logistic regression. **Results:** Soursop was known to 83 respondents (98.8%), mainly for its leaves (98.8%); knowledge was mostly inherited within the family (66.3%). The most frequently suggested indications were hypertension (78.0%), diabetes (75.6%), infections (65.9%) and prostatic disorders (62.2%; fidelity level = 62.2%). Thirty-nine of 79 respondents (49.4%) had already used or recommended the leaves for the prostate, particularly traditional healers (88.2%). The main preparation was an aqueous decoction or infusion (84.6%) taken orally, twice daily (82.8%) with honey (96.8%). Perceived efficacy was high (median 8/10; ≥ 7 in 78.9%), but 89.5% of respondents reported at least one adverse effect, mainly nausea (71.1%). Cost (60.5%) and lack of trust (63.2%) were the main barriers to biomedical care. Reported use differed markedly by survey area, an effect inseparable from the interviewer. **Conclusion:** *A. muricata* leaves hold an established place in the urban pharmacopoeia of Greater Lomé for prostatic disorders, with poorly standardised practices, modest gastrointestinal tolerability and frequent mixed care-seeking. These findings call for botanical authentication, chemical characterisation of traditional preparations, toxicity studies and structured collaboration between traditional healers and urology services.

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INTRODUCTION

Prostate cancer is a major public health problem: according to GLOBOCAN 2022 estimates, it ranks second among cancers in men worldwide, with approximately 1.5 million new cases (1). In sub-Saharan Africa, the disease is most often discovered at a locally advanced or metastatic stage. In Togo, prostate cancer is the leading cancer in men (2,3). In the prospective series from the Sylvanus Olympio University Hospital in Lomé (232 cases over three years), the mean age at diagnosis was 68.5 ± 9.6 years, the median PSA level 123.5 ng/mL, 75.9% of tumours were already metastatic and only 6.4% of

patients had been able to undergo radical prostatectomy (2). Previous work on the subject in Togo has been essentially epidemiological and histological (2,4). Benign prostatic hyperplasia (BPH), whose histological prevalence increases with age and affects the majority of men over 60 (5), causes lower urinary tract symptoms (dysuria, frequency, nocturia, weak stream) that impair quality of life and, together with cancer, account for most urological consultations. Access to investigations (PSA, ultrasound, biopsy, MRI) and specialised treatment remains limited by cost, by the concentration of technical facilities in the capital and by the distrust of part of

the population towards healthcare facilities (2). In this context, traditional medicine remains a major recourse, recognised by the World Health Organization as a component of the health systems of many countries (6). Togo has a rich pharmacopoeia tradition, documented since the 1980s (7), but the plants used for prostatic disorders have not been the subject of a dedicated ethnopharmacological survey. *Annona muricata* (Annonaceae), known as soursop, corossol or graviola, is a tropical fruit tree whose leaves, fruits, seeds, bark and roots are used in folk medicine in Africa and Latin America (8). More than one hundred Annonaceous acetogenins have been isolated from the species, alongside alkaloids and flavonoids (8). Preclinical studies report antiproliferative and pro-apoptotic activities on cancer cell lines (9,10). With regard to the prostate, an aqueous leaf extract inhibited the proliferation of BPH-1 cells in a dose-dependent manner and reduced prostate size in rats (11); the combination of flavonoids and acetogenins in the leaves showed a protective synergy in prostate cancer models, including xenografts (12); and an acetogenin-rich fraction attenuated testosterone-induced BPH in rats (13). These data remain experimental. At the same time, annonacin, the main acetogenin, is neurotoxic *in vitro* and in animals, and chronic consumption of Annonaceae products has been associated with atypical parkinsonian syndromes in the French West Indies (14,15), which calls for caution regarding prolonged use (9). To our knowledge, no study has systematically described the use of *Annona muricata* for prostatic disorders in Togo: who uses it, how preparations are made, what efficacy and tolerability are reported, and how this use fits into the biomedical care pathway. Documenting these practices is a prerequisite for any rigorous scientific evaluation and for making its use by the population safer. The general objective of this study was to document knowledge and practices relating to *Annona muricata* in the treatment of prostate cancer and BPH in Togo. The specific objectives were: (i) to describe the characteristics of respondents and their sources of knowledge; (ii) to identify the plant parts used, indications and methods of preparation and administration; (iii) to assess perceived efficacy and adverse effects; (iv) to describe supply, storage, costs and sociocultural dimensions; (v) to characterise the interface with biomedical care; and (vi) to identify factors associated with reported use for the prostate.

MATERIALS AND METHODS

Study type and study area: This was a cross-sectional, descriptive and analytical ethnopharmacological survey conducted from 31 December 2025 to 25 January 2026. Togo is a West African country bordering the Gulf of Guinea, with more than eight million inhabitants and five administrative regions. The southern part, with a Guinean-type tropical climate, offers favourable conditions for soursop and hosts the main medicinal plant markets. The survey took place in Greater Lomé (Maritime region), the economic capital and home of the national urology referral centre, in the prefectures of Golfe ($n = 40$ interviews) and Agoè-Nyivé ($n = 44$), in neighbourhoods and markets such as Agoè-Assiyéyé, Atsanvé, Anomé, Togblé, Adjougba, Agbalépédo, Totsi and Cacavéli. Geographical coverage is therefore urban and peri-urban, not national.

Study population and sampling: The target population comprised knowledge holders and users of traditional medicine: traditional healers, male and female medicinal plant sellers, herbalist assistants, as well as patients or former

patients and family caregivers. Sampling was non-probabilistic, purposive convenience sampling, with participants met at their places of activity, particularly markets. No *a priori* sample size calculation was performed, as the study was exploratory. In total, 84 respondents were interviewed by five interviewers. Participants had to give consent and agree to answer in French, Ewe, Mina, Kabye, Tem or another local language.

Plant material and sample collection: The plant material studied consisted of the leaves of *Annona muricata* L. (Annonaceae). When the respondent agreed, a sample of leaves (dried or fresh) was collected and packed in a bag, with a photograph of the plant on site and, where applicable, of the preparation. Samples were intended for a botany laboratory/herbarium for authentication.

Ethnopharmacological survey: Data were collected through individual semi-structured interviews lasting about 45 minutes per respondent, using a questionnaire digitised in KoboToolbox. After identification information (date, interviewer, prefecture, neighbourhood/village) and consent, the questionnaire comprised twelve sections: (1) sociodemographic and professional characteristics; (2) knowledge of soursop, vernacular names, visual recognition, known plant parts, sources of knowledge; (3) spontaneous and suggested indications, frequency of use, target population; (4) use for the prostate, with subsections 4A (preparation), 4B (co-administration), 4C (perceived efficacy) and 4D (adverse effects); (5) supply, drying, storage and price; (6) sociocultural and ritual dimensions; (7) care pathway and interface with biomedicine; (8) course of a treatment case (diagnosis, protocol, perceived progress, adverse effects experienced, expenditure); (9) costs and accessibility; (10) acceptability; (11) documentation and samples; (12) closure and interviewer observations. The ethnobotanical data covered: plant names, parts used, plant characteristics, method of preparation, traditional use and routes of administration of the remedies. The items studied were the respondent's occupation, knowledge of plants, medicinal use specific to prostatic disorders (cancer, BPH) and perceived efficacy. Sections 4 to 7 were asked only of respondents who reported having already used or recommended the leaves for the prostate ($n = 39$); section 8 was completed by a larger group (up to 53 responses depending on the item).

Ethical considerations: Free and informed consent was obtained orally before each interview, with verification of understanding of the study objective and separate agreement for photographs of the plant or preparations, without faces. Data were anonymised (questionnaire code, no personal data analysed). The study complied with the Declaration of Helsinki (19), the Code of Ethics of the International Society of Ethnobiology (20) and the principles of fair benefit-sharing related to traditional knowledge.

Data analysis and processing: Data were exported from KoboToolbox in Excel format and then processed with SPSS 25 and Stata 17. Cleaning included: harmonisation of spelling variants in free-text fields (prefecture, ethnic group, religion, occupation, vernacular names); recoding of multiple-choice questions into binary variables; numerical conversion of amounts in CFA francs ("5 milles fca" = 5,000; ranges were replaced by their midpoint). Qualitative variables are described by counts and percentages, quantitative variables by mean $\pm$ standard deviation or median (interquartile range), depending

on the distribution. Two ethnobotanical indices were calculated: the relative frequency of citation (RFC = FC/N, where FC is the number of informants citing an indication and N the total number of informants) (16,18) and the fidelity level (FL = $I_p/I_u \times 100$, where I_p is the number of informants citing the species for a main indication and I_u the total number citing it for any use) (17). Comparisons were based on Pearson's χ^2 test or Fisher's exact test (expected counts < 5), the Mann-Whitney U test and the Kruskal-Wallis test for ordinal scores, and Spearman's rank correlation coefficient. Determinants of reported use of the leaves for the prostate were explored by multivariable logistic regression (sex, traditional healer status, patient status, secondary or higher education, prefecture). The 14 bivariate tests were corrected for multiple comparisons using the Holm method (21) and are presented as exploratory. The significance threshold was set at 0.05 (two-sided).

RESULTS

Characteristics of respondents: The surveyed population of 84 people was predominantly female (65.5%), versus 34.5% male. Medicinal plant sellers were the main occupational category (63.1%), followed by traditional healers (21.4%). In terms of education, secondary (35.7%) and primary (34.5%) levels were the most represented, while 20.2% of respondents had received no formal education. Socioculturally, the Ewe and related groups were the majority (59.5%), and Christianity was the most frequently reported religion (45.2%). Finally, the geographical distribution was relatively balanced between Agoè-Nyivé (52.4%) and Golfe (47.6%). Overall, the sample is thus characterised by a strong representation of women and of stakeholders directly involved in the trade and practice of traditional medicine.

Table 1. Sociodemographic and professional characteristics of respondents (N = 84)

Characteristic	n	%
Sex		
Women	55	65,5
Men	29	34,5
Status		
Medicinal plant seller	53	63,1
Traditional healer (TH)	18	21,4
Patient / former patient	8	9,5
Caregiver / family	3	3,6
Other (practitioner-seller, amateur)	2	2,4
Education level		
None	17	20,2
Primary	29	34,5
Secondary	30	35,7
Higher	8	9,5
Ethnic group (self-reported)		
Ewe and related (Ewe, Mina, Adja...)	50	59,5
Central/Northern groups (Kabye, Losso, Bassar, Moba, Nawdba)	10	11,9
Kotokoli (Tem)	8	9,5
Yoruba/Anago/Ifè-Ana	6	7,1
Ghanaian/Akan origin	2	2,4
Not reported	8	9,5
Religion (self-reported)		
Christianity	38	45,2
Traditional religions/animism	17	20,2
Islam	12	14,3
No religion	2	2,4
Not reported	15	17,9
Survey prefecture		
Agoè-Nyivé	44	52,4
Golfe	40	47,6

Knowledge of soursop, vernacular names and sources of knowledge: Soursop was known to 98.8% of respondents and recognised from a photograph or sample by 93.8%. Of the 76 respondents who gave a vernacular name, 41 (53.9%) used *Agnigli* or *Gnigli* and 28 (36.8%) *Evo* (*Évo*, *Vo*, *Évou*), 9 citing both; 11 mentioned other local names (*Tôtô*, *Abo ibobo*, *Alôm*, *Kaci*, *Lolo*, *Sunkungo*, *Kósól*, *Lougou*) and 5 knew only the French name or had forgotten it.

Of the 83 respondents to the question on plant parts used for treatment, the leaves were almost universally known or used (82; 98.8%), ahead of fruits (57; 68.7%), roots (54; 65.1%), bark (36; 43.4%) and seeds (33; 39.8%) (Figure 1A). Knowledge came from family inheritance (55; 66.3%), a master or mentor (31; 37.3%), the internet (14; 16.9%), clients or patients (13; 15.7%) and books (7; 8.4%) (Figure 1B).

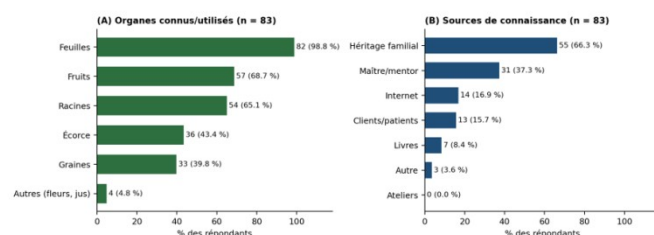


Figure 1. Soursop plant parts known or used (A) and sources of knowledge (B)

Therapeutic indications: Among respondents who answered the list of suggested indications, the highest relative frequencies of citation (RFC) concerned hypertension (64; 78.0%), diabetes (62; 75.6%), infections (54; 65.9%) and prostatic disorders (51; 62.2%), followed by other cancers (45; 54.9%) and pain (45; 54.9%) (Figure 2). The fidelity level for prostatic disorders was 62.2%. The analysis shows that traditional practitioners and plant sellers give the leaves a median priority score of 7/10 relative to other plant parts. Use over the previous 12 months was occasional (24; 29.3%), daily (22; 26.8%), monthly (18; 22.0%) or weekly (17; 20.7%) (n = 82). The target population included adults (96.3%), men (86.3%), women (81.3%), older people (72.5%) and children over 12 years (51.3%).

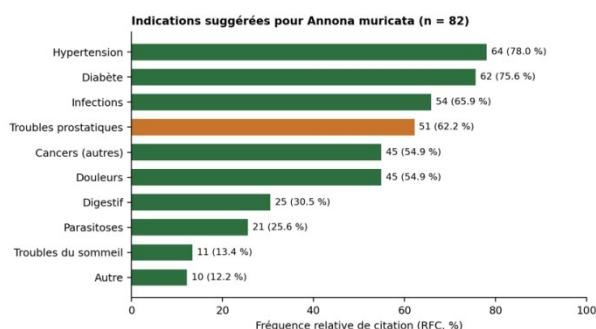


Figure 2. Relative frequency of citation (RFC) of suggested indications (*Annona muricata*)

Use of the leaves for prostatic disorders: In total, 49.4% reported having already used or recommended the leaves for the prostate. This use concerned 88.2% of traditional healers, 62.5% of patients or former patients and 36.7% of sellers. The main situations mentioned were urinary symptoms (89.7%), diagnosed "cancer" cases (76.9%), prevention (56.4%), benign

prostatic hyperplasia (38.5%) and post-operative care (30.8%). The objectives sought were mainly relief of urinary symptoms (89.7%), anti-inflammatory (82.1%) and analgesic (76.9%) effects, while improvement of sleep or appetite was less frequently cited (33.3%), as was an antitumour effect (17.9%). To guide these uses, respondents reported relying mainly on digital rectal examination (45.8%), blood tests or PSA (41.7%), and empirical or local criteria (37.5%). General signs such as fever, fatigue or pain were mentioned less often (16.7%).

Preparation, administration and precautions: The leaves were used as a mixture of young and mature leaves (61.5%), mature leaves only (25.6%) or young leaves only (12.8%), most often shade-dried (48.7%), sun-dried (25.6%) or fresh (20.5%). The solvent was water (84.6%), alcohol (10.3%) or infusion (5.1%), and the route was oral (97.4%), with one case of enema reported. Quantities were expressed in a non-standardised way: fraction of a glass, spoonful, handful of leaves per litre of water, or a beer glass three times a day. Doses were taken twice daily (morning and evening). Regarding treatment duration, 20 responses gave a quantified duration, 14 of which (70.0%) were three months; 15 mentioned only a unit of time. Honey was added in 30 of 31 cases (96.8%), and plant adjuvants in 21 cases: lemongrass (85.7%), lemon (61.9%) and clove (1). Twenty respondents cited co-administered plants: local plant “maougène” (5), moringa (3), papaya (3), basil, rosemary or hyssop (2), mango bark (1), kinkeliba (1) and pineapple peel (1). Eighteen of the 39 respondents (46.2%) reported concomitant use of modern medicines, antibiotics being the only class cited.

Table 2. Methods of preparation and administration of *A. muricata* leaves for prostatic disorders

Parameter	Modality	n/N	%
Leaves	Mixture of young + mature	24/39	61,5
	Mature	10/39	25,6
	Young	5/39	12,8
State	Shade-dried	19/39	48,7
	Sun-dried	10/39	25,6
	Fresh	8/39	20,5
	Ground	2/39	5,1
Solvent	Water (decoction)	33/39	84,6
	Alcohol	4/39	10,3
	Infusion	2/39	5,1
Route	Oral	38/39	97,4
	Enema	1/39	2,6
Doses per day	Two (morning and evening)	24/29	82,8
	Three	3/29	10,3
Quantified treatment duration	Three months	14/20	70,0
Plant adjuvants	Lemongrass	18/21	85,7
	Lemon	13/21	61,9
Non-plant product	Honey	30/31	96,8
Concomitant use of modern medicines	Yes	18/39	46,2

The reported precautions for use mainly concerned eating unsweetened, lukewarm food (38.7%), adhering to the dosage to avoid overdose (32.3%) and avoiding alcohol (12.9%). Regarding dietary restrictions, red or processed meat was the main food cited as to be avoided (54.5%), followed by sweet, fatty or oily foods (31.8%) and alcohol (18.2%). In addition, some respondents recommended physical activity. The main situations considered as exclusion criteria or contraindications were overdose, disease stage, previous or ongoing treatments, pregnancy and the frailty of the persons concerned.

Perceived efficacy and adverse effects: Perceived efficacy on a 0–10 scale was high: mean 7.3 ± 1.4 , median 8 (7–8), range 3–9, with a score ≥ 7 in 78.9% (Figure 3A). Time to improvement was 1 to 2 weeks (39.5%), more than one month (23.7%), 2 to 4 weeks (21.1%) or less than one week (15.8%). The symptoms reported as improved were dysuria (76.3%), pelvic pain (73.7%), fatigue (73.7%), weak stream (42.1%), frequency and nocturia (15 each; 39.5%) and weight loss (34.2%) (Figure 3B). In the section on a treatment case, perceived progress reached a median of 7 (6–8) out of 10 and was ≥ 7 . Two anonymised case accounts, anecdotal in nature, describe respectively the resumption of urination in a hospitalised patient whose dysuria did not respond to treatment, and night-time relief with restored sleep in a patient in pain. Only 28.9% reported a diagnosis made by a health professional, and 4.9% were currently under medical follow-up.

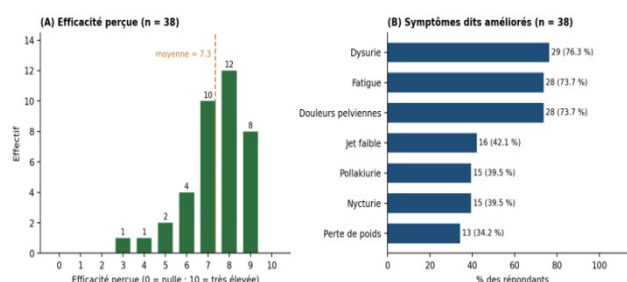


Figure 3. Perceived efficacy of *A. muricata* leaves for prostatic disorders (A) and symptoms reported as improved (B)

Of the 38 respondents to the tolerability section, 34 (89.5%) reported at least one adverse effect: nausea (71.1%), vomiting (31.6%), dizziness (28.9%), palpitations (10.5%), diarrhoea (10.5%) and constipation (2.6%); four (10.5%) reported none and no rash was reported (Figure 4A). Severity, according to the WHO scale, was moderate in 22 cases (57.9%) and mild in 16 (42.1%), with no severe cases. Management consisted of dose reduction (16/31; 51.6%) or discontinuation (2/31; 6.5%). The populations considered at risk were people with renal failure (22/37; 59.5%), frail individuals (11; 29.7%), patients on multiple medications (2) and those with liver disease (2).

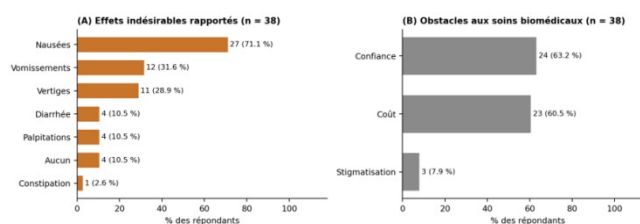


Figure 4. Adverse effects reported with *A. muricata* leaves (A) and barriers to biomedical care (B)

Supply, storage, costs and accessibility: The leaves came from the market (94.9%), home gardens (89.7%), the bush (87.2%), dedicated cultivation (48.7%) or gifts and exchanges (15.4%). Harvesting took place all year round (92.3%). Drying was done in the shade (56.4%), in the sun (35.9%) or in an oven (5.1%), and storage was in plastic bags (84.6%), cardboard (12.8%) or jute sacking (2.6%). The storage duration cited was about 6 months (6 months to one year) in 20 of 33 responses (60.6%), and considered “indefinite” in 3. Empirical criteria of spoilage were changes in colour, smell or taste and mould. The median cost of a course of treatment was 2,500 FCFA (500–5,000) (n = 67; range 200–25,000; mean

4,501), and the monthly expenditure reported by users was 10,000 FCFA (range 200–20,000). Accessibility was rated as moderate (50.6%), very easy (20.3%), easy (11.4%), difficult (13.9%) or very difficult (3.8%), and availability as stable (55.1%) or variable (41.0%), the leaves being more abundant in the rainy season.

Table 3. Supply, storage, costs and acceptability

Parameter	Result	n/N or value
Origin of leaves (n = 39)		
Market	94,9 %	37/39
Home garden	89,7 %	35/39
Bush	87,2 %	34/39
Dedicated cultivation	48,7 %	19/39
Gift / exchange	15,4 %	6/39
Storage (n = 39)		
Shade drying	56,4 %	22/39
Storage in plastic bag	84,6 %	33/39
Storage duration cited: ~ 6 months (6 months–1 year)	60,6 %	20/33
Costs		
Cost of a course of treatment, median [IQR]	2,500 FCFA [500–5,000]	n = 67
Monthly expenditure, median (range)	10,000 FCFA (200–20,000)	n = 29
Taste / smell (n = 80)		
Neutral	82,5 %	66/80
Pleasant	13,8 %	11/80
Unpleasant	3,8 %	3/80
Acceptability of the mode of administration (n = 79)		
Moderate	75,9 %	60/79
High	20,3 %	16/79
Low	3,8 %	3/79
Estimated adherence (n = 80)		
Moderate	60,0 %	48/80
Good	32,5 %	26/80
Low	7,5 %	6/80

Note: IQR = interquartile range; FCFA = CFA franc.

Sociocultural dimensions and care pathways: Prostatic disorders were attributed to a natural age-related cause (81.6%), to diet (13.2%) or to a spiritual cause. Among respondents describing a symbolic role for soursop, 48.6% cited protection or purification, 37.1% use as food or herbal tea and 11.4% action against cancer, the prostate or infections. Of the 22 respondents on ritual practices, 5 reported none; the others mentioned leaving a coin when harvesting (3) or the use of *Calotropis procera* (5) and papaya leaves (3). The therapeutic decision lay with the head of the family (63.2%), the traditional healer (21.1%), the person concerned (7.9%) or a council of elders (5.3%). The usual first recourse was modern care (55.3%) or the traditional healer (44.7%).

All respondents (100%) reported cross-referral between traditional healers and hospital, and 64.9% mixed follow-up. The biomedical examinations mentioned were ultrasound (39.5%), PSA (23.7%), biopsy (23.7%) and MRI (10.5%). Barriers to biomedical care were lack of trust (63.2%), cost (60.5%) and stigma (7.9%), while distance and availability were never cited (Figure 4B). 9. Factors associated with reported use and perceived efficacy. Use of the leaves for the prostate differed by status ($\chi^2 = 15.68$; $df = 3$; $p = 0.001$): traditional healers reported this use more often than other respondents (88.2% vs 38.7%; Fisher's exact test $p < 0.001$; Holm-adjusted $p = 0.004$) (Figure 5A). The difference by sex (67.9% in men vs 39.2% in women; $p = 0.019$) did not withstand Holm correction ($p = 0.17$), nor did the differences by education level ($p = 0.37$), formal training in herbal medicine ($p = 0.12$) or length of experience (median 8 vs 10

years; $p = 0.20$). Among users, perceived efficacy was correlated with the priority score given to the leaves relative to other plant parts (Spearman's $\rho = 0.50$; $p = 0.002$; adjusted $p = 0.020$; $n = 37$) and varied with time to improvement (Kruskal-Wallis, $p = 0.003$; adjusted $p = 0.031$), without a monotonic gradient ($\rho = 0.15$; $p = 0.38$; medians of 7, 7, 9 and 8 for times of < 1 week, 1–2 weeks, 2–4 weeks and > 1 month). Efficacy tended to be higher with young leaves (median 9; $n = 5$) and mature leaves (8; $n = 10$) than with the mixture (7; $n = 23$) ($p = 0.008$; adjusted $p = 0.083$), among users concomitantly taking modern medicines (median 8 vs 7; $p = 0.050$) and among those reporting more adverse effects ($\rho = 0.37$; $p = 0.024$), but these associations were not significant after correction. No difference was observed by solvent ($p = 0.44$) or status ($p = 0.17$).

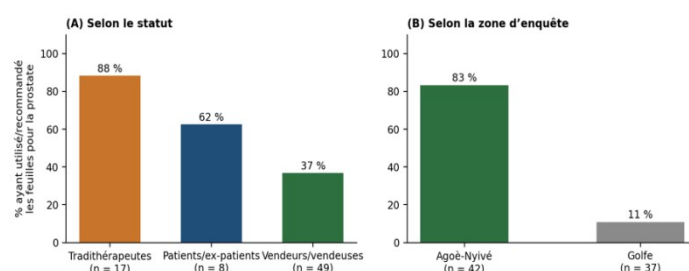


Figure 5. Proportion of respondents who had used or recommended *A. muricata* leaves for the prostate by status (A) and survey prefecture (B) (n = 79)

Table 4. Factors associated with reported use of the leaves for the prostate: multivariable logistic regression (n = 79)

Variable	Adjusted OR	95% CI	p
Male (ref.: female)	1,38	0,26–7,46	0,71
Traditional healer (ref.: other statuses)	10,13	1,03–99,44	0,047
Patient / former patient (ref.: other statuses)	0,84	0,09–8,25	0,88
Secondary or higher education (ref.: none/primary)	2,11	0,50–8,87	0,31
Golfe prefecture (ref.: Agoè-Nyivé)	0,026	0,006–0,114	< 0,001

Note: McFadden's $R^2 = 0.49$. The wide intervals reflect the small sample size; the "prefecture" effect is confounded with the interviewer.

Table 5. Summary of exploratory bivariate tests and Holm correction (14 tests)

Comparison	Raw p	Adjusted p (Holm)
Prefecture × use for the prostate (χ^2)	< 0,001	< 0,001
Traditional healer status × use (Fisher)	< 0,001	0,004
Efficacy × leaf priority score (Spearman)	0,002	0,020
Efficacy × time to improvement (Kruskal-Wallis)	0,003	0,031
Efficacy × leaf type (Kruskal-Wallis)	0,008	0,083
Sex × use (Fisher)	0,019	0,173
Efficacy × number of adverse effects (Spearman)	0,024	0,190
Leaf priority × use (Mann-Whitney)	0,043	0,303
Efficacy × concomitant use of modern medicines (Mann-Whitney)	0,050	0,303
Formal training × use (Fisher)	0,115	0,575
Efficacy × status (Mann-Whitney)	0,173	0,693
Length of experience × use (Mann-Whitney)	0,203	0,693
Education level × use (χ^2)	0,375	0,750
Efficacy × solvent (Mann-Whitney)	0,435	0,750

DISCUSSION

- **Widely shared, inherited knowledge centred on the leaf**
Soursop is known to almost all respondents and visually recognised by more than nine out of ten, reflecting its place

in everyday life in Greater Lomé, where the tree is grown in gardens and its leaves are sold in markets. The predominance of the leaf (98.8%) over other plant parts is consistent with the literature, in which it is the most studied part phytochemically and pharmacologically (8,9), and offers a sustainability advantage, since leaf harvesting preserves the tree, unlike harvesting of bark or roots. Transmission remains mainly familial (66.3%) or through apprenticeship (37.3%), with almost no formal training (5.1%), which characterises an oral, poorly codified knowledge vulnerable to erosion; however, the emergence of the internet as a source (16.9%) signals a reshaping of knowledge under the influence of unverified content. The two dominant names, *Agnigli* and *Evo*, are useful entry points for future surveys.

- A multipurpose plant used for the prostate mainly by traditional healers. The dominant indications (hypertension, diabetes, infections) match those reported in reviews of the species, which also mention cancers, pain and parasitic diseases (8,9). The fidelity level of 62.2% for prostatic disorders confirms a recognised but non-exclusive use: soursop is a multipurpose plant, which complicates the attribution of specific effects and makes co-use with other treatments plausible. Reported use for the prostate was concentrated among traditional healers (88.2%), with a high but very imprecise adjusted odds ratio (10.1; 95% CI 1.03–99.4), which is to be expected for a specialised therapeutic use.
- **Preparation practices:** Consistency with experimental data and need for standardisation. The preparation profile (aqueous decoction or infusion of shade-dried leaves, two doses per day, three-month course, combined with honey and lemongrass) is relatively homogeneous in form but not in quantities, expressed as fractions of a glass, spoonfuls or handfuls, which precludes any comparison with experimental doses. The choice of water as the main solvent (84.6%) can be related to the work of Asare *et al.*, in which an aqueous leaf extract decreased the viability of BPH-1 cells ($IC_{50} = 1.36$ mg/mL) and reduced prostate weight in rats, with modulation of Bax and Bcl-2 consistent with induction of apoptosis (11). Conversely, in an *in vitro* study on other cell lines, the ethanolic extract was cytotoxic whereas the aqueous extract was not (10), which may be attributed to the lipophilicity of acetogenins, which are better extracted by ethanol.

Perceived efficacy, tolerability and safety: Perceived efficacy is high (median 8/10), and the symptoms reported as improved (dysuria, weak stream, frequency, nocturia) correspond to the picture of lower urinary tract symptoms, the respondents' main target. These perceptions are, however, subjective, reported by practitioners and sellers with an interest in promoting the product, and are not based on any objective measurement (IPSS score, uroflowmetry, PSA, imaging). Improvement in fatigue or pain, which are non-specific, may reflect natural history, a placebo effect or concomitant treatments, including the reported co-use of modern medicines by 46.2% of users. The correlation between efficacy and the number of adverse effects ($p = 0.37$, not significant after correction) could reflect a perceived dose effect, although no causal relationship can be established. To our knowledge, no controlled clinical trial has demonstrated the efficacy of *Annona muricata* in prostate cancer or BPH; the available data are preclinical (9,11–13). It should therefore be stressed that these results do not allow any conclusion of therapeutic efficacy.

In terms of tolerability, the frequency of gastrointestinal events (nausea 71.1%, vomiting 31.6%) and dizziness (28.9%), and moderate severity in nearly six cases out of ten, indicate an unfavourable profile, which practitioners manage mainly by reducing the dose. Two aspects call for particular vigilance. First, the frequently cited three-month course entails prolonged use, whereas the neurotoxicity of annonacin, observed *in vitro* and in animals and associated with atypical parkinsonism in Guadeloupe, appears to depend on prolonged exposure (9,14,15); however, the molecule's low bioavailability and the absence of quantification in local preparations prevent estimation of the actual risk. Second, the simultaneous indication of the leaves for hypertension and diabetes raises concerns about additive effects with antihypertensive or hypoglycaemic treatments, while the respondents' own designation of people with renal failure (59.5%) as an at-risk population is consistent with an empirical caution whose toxicological basis remains to be established.

Supply chain, quality and accessibility: Supply is dominated by markets (94.9%) and home gardens (89.7%), with year-round availability (92.3%) and an apparently modest median cost per course (2,500 FCFA), which partly explains the appeal of this recourse. Storage in plastic bags (84.6%) for up to six months, without any objective moisture-control criterion, promotes fungal growth and degradation of constituents, and the variability of origin (garden, bush, market) suggests strong heterogeneity of composition. These findings argue for simple drying, packaging and storage recommendations for sellers, and for chemical characterisation of representative batches.

Therapeutic pluralism and opportunities for integration:

The care-seeking profile is one of acknowledged pluralism: first recourse is biomedical for 55.3% of users, cross-referral is reported by all, and mixed follow-up by nearly two thirds. Barriers to biomedical care are above all lack of trust (63.2%) and cost (60.5%), with distance and availability never cited, reflecting the urban context. This openness is an opportunity, but it coexists with a risk: the great majority of respondents had no diagnosis made by a professional (66.7%) and almost none were under current medical follow-up (4.9%). In a country where three out of four patients already present with metastatic disease (2), the use of traditional preparations for an unconfirmed "cancer" could delay diagnosis and treatment. The respondents themselves recommend building trust through training and recognition of traditional healers. A structured referral system, combining training of practitioners to recognise warning signs, early referral to urology and informing patients about the limits of the evidence, thus appears to be the most directly actionable measure.

CONCLUSION

This first ethnopharmacological survey devoted to *Annona muricata* for prostatic disorders in Togo shows that soursop leaves are widely known and used, mainly as a twice-daily aqueous preparation combined with honey, with high perceived efficacy but poor gastrointestinal tolerability, insufficient standardisation and frequent use alongside biomedical care. These results are based on statements by urban stakeholders, with interviewer-related heterogeneity, and do not constitute proof of efficacy. They justify a validation chain ranging from botanical authentication to toxicology and clinical studies, as well as a collaborative framework between

traditional healers and urologists to make use safer and avoid delays in the diagnosis of prostate cancer.

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