

Ethnopharmacological Survey of *Garcinia Pedunculata* Roxb. Fruit in Six Different Districts of Assam, India

Rahul Sarma¹, Rajlakshmi Devi^{1*}

¹(Division of Life Sciences, Institute of Advanced Study in Science and Technology, Guwahati-781035, Assam, India)

ABSTRACT : *Gastrointestinal diseases (GDs) have been a cause of concern mostly in the rural parts of developing countries worldwide. The rural Assam is predominantly inhabited by tribal people and they are primitive indigenous community and most of them are also socio-economically backward. These people have been traditionally using natural medicine for curing of different diseases instead of allopathic medicines. In this study we have tried to scientifically enumerate the ethnomedicinal use of *Garcinia pedunculata* Roxb. (Family: Clusiaceae) (GP) fruit in six different districts of Assam of Northeast region of India. Open-ended and semi structured questionnaire were prepared and distributed among different sections of people. In the study, total 2,600 samples at random were collected from six districts of Assam and out of that 1,967 numbers of people (75%) use GP fruit and they consider it as a healer of dysentery, diarrhea and jaundice. The present study reveals some important facts like popularity of GP for treatment of GDs, distribution of GP in different districts of Assam, gradual extinction of GP due to various threats which will create awareness among different communities for conservation of GP for future use.*

KEYWORDS : *Gastrointestinal diseases (GDs), *Garcinia pedunculata*, Assam, ethnomedicine, Northeast India.*

I. INTRODUCTION

The rural people of Assam predominantly occupied by aboriginal tribal people and they have been pursuing heavily on traditional system of healthcare from the plant resources for treatment of different diseases. In many cases, plants used as herbal remedies are not only important as drugs but also as food supplements with vitamins and minerals [1]. Since the early age of Rig-Veda, the traditional system of medicine in Assam in particular and India in general prescribing plant extractives in therapy. There are a lot of proofs of the application of various medicines prepared of different herbs in curing diseases in Vedas and Upanisads. These traditional systems of medicine led to the evolution of Ayurveda, which literally means science of life. According to WHO, herbal medicines serve the health needs of about 80% of the world's population, especially for millions of people in the rural areas of developing countries [2]. WHO has also recognized the role of traditional medicine in the primary health care system [3]. The WHO has emphasized the importance of the traditional indigenous medicines, since a large mainstream of rural folk people in the developing countries still use these medicines as the first safety in health care [4]. Traditional medicines are continuously increasing in their status, and show that there are some features, which are unique to this medicine, contributing to both efficacy and safety [5]. In recent years, special attention is being paid on alternative natural bio-remedies to cure the diseases because of their less or no side effects, high efficacy and less cost [6]. The tribal belt population of India presents an interesting profile of ethnic diversity and there are altogether 427 tribal communities all over India [7]. Most of the tribal people of Assam depend their livelihood by using plants for different medicinal purposes. Several ethnobotanical investigations have been carried out at different parts of the world to explore the traditional treatment out of various medicinal plants. But no systematic ethnobotanical survey or investigation is being carried out in Assam for treatment of different diseases. Because of lack of awareness, proper sanitation, climatic reason, topography etc. the different diseases have affected the rural inhabitants of Assam from time to time. One of the most notable is different type of GDs.

Dysentery broadly refers to infectious GDs characterized by inflammation of the intestines, chiefly the colon. The World Health organization (WHO) defines dysentery as an episode of diarrhea in which blood is present in loose, watery stools. Amoebic dysentery is more serious condition than bacillary dysentery [8]. Dysentery accounts for about 15% of all deaths [9]. There are some 42 million cases annually and an estimated 75,000 deaths across the globe due to amoebic dysentery alone [10].

Several ethnobotanical investigations have been carried out at different parts of the world to explore the traditional treatment against gastrointestinal disorders [11]. Different researchers have been investigating from time to time to find out the proper herbal treatment for healing GDs in Assam. The members of the genus *Garcinia* are potential, high valued medicinal plants and have antimicrobial activity [12]. The genus has about 200 species native to South Asia ranging Southern part of the Thailand and Peninsular Malaysia to Indonesia, distributed in South East Asian region [13]. In Peninsular Malaysia there are 49 *Garcinia* species out of 350 species estimated worldwide [14]. In India, 30 species reported by T. Anderson in Flora of British India (1874). Among the 35 species reported by Maheswhari [15] (1964), 15 species are included in Northeast India. Kanjilal *et al.*, 1934 [16] reported 9 species from undivided Assam. Kar *et al.*, 2008 [17] reported 8 species from Sonitpur district of Assam. Some species of *Garcinia* are cultivated for medicinal purposes. The latex of *Garcinia cowa* (GC) is used in Thai folk medicines as an antifever agent [18]. Members of *Garcinia* used after childbirth medication, for menstrual problems, dysentery and fever in traditional system of medicine [19] and also recorded that some species have potential treatment for HIV [20] and Cancer [21]. There is hearsay belief among the people of Assam that by using *Garcinia* species the GD can be cured but there is no proper research or study on the subject so far. As such a detail study on the use of *Garcinia* species for treatment of GDs etc. has become a need of the hour. In Assam different types of *Garcinia* species found available but these species are not abundant throughout Assam except GP. The other species of *Garcinia* except GP are scarcely found in different parts of Assam mostly in the hill areas. Considering the utility of GP fruit, the rural people of Assam still cultivating the plant but not in a scientific manner. If proper measures are not taken up for the conservation of the species the possibility of extinction of the species cannot be ruled out in near future. In this regard views of some rural people are also tried to be highlighted in the study.

II. MATERIALS AND METHODS

Study area: Northeast India is consisting of seven states. All these states are very rich in natural resources including different kinds of medicinal plants. Among the seven states Assam has distinct and some special features relating to its demography, climate, soil topography etc. Assam is located between latitude of $24^{\circ}3' N$ and $27^{\circ}58' N$ and between longitude $89^{\circ}5' E$ and $96^{\circ}1' E$. It has a total surface area of 78,438 sq km and with an estimated population of 3,11,69,272 [22].



Map 1. Location map of the surveyed districts of Assam

The state is famous for beautiful hills and hillocks, rivers, floras and faunas with unique biodiversity. It is a habitat of different ethnic groups. Assam is basically an agricultural-based state and majority of its population resides in villages. The villages of Assam are full of different kinds of valuable plants and these have been the corner stone of medicinal therapies for years together. The flora of Assam is characterized by a significant percentage of endemic and indigenous medicinal plants. These medicinal plants have been using by the rural people for taking different health cares. But due to rapid urbanization leads to the negative impact on the medicinal plants which causes decrease in primary forest and extinction of some important species of flora and fauna.

GP is a plant species used by the people of Assam as a medicinal plant for healing different GDs. Taking that into consideration six districts of Assam viz., Kamrup Metro (M), Kamrup Rural (R), Nalbari, Barpeta, Dhemaji and Lakhimpur covering both upper Assam and lower Assam have been selected for a field study to know the use of GP fruit by the people and its medicinal effect, if any. Map 1 illustrates the selected six districts of Assam where by the survey was carried out.

Ethnobotanical survey : The survey was performed using semi structure questionnaires [23] via a face to face interview and circulated these questionnaires (Appendix A) among cross section of people above 18 years of age and about 2,600 numbers of filled up reports as per age cohort have been collected visiting different areas of above mentioned districts. A questionnaire in Assamese language was prepared about the use of GP by the people in different districts of Assam. The survey was conducted during October 2013-June 2014 around eight months. The interviewers himself visited different parts of the above districts and interacted with elderly people of different parts of the districts to obtain their experiences about the utility they derived from consuming GP and as to whether they have been traditionally using GP for healing any stomach related disorders. The survey covered different age groups of both the sexes who reportedly used GP to treat GDs, whose gender, age, educational background, professional status and experience on the use of GP were also documented. The record of questionnaires used include the following information: (a) the local name, (b) fruit part used, (c) method of preparation, (d) mode of application, (e) GD and other medicinal uses, (f) dose and dosage forms and (g) whether they get relief by using it, (h) conservation status of the plant.

Quantitative ethnobotanical data : Fidelity level (FL) was applied for diseases or ailments that were reported most commonly. It is a ratio of informants claiming the use of a plant species for a particular purpose and number of informants using the plant species to treat any given diseases. It was calculated as shown below [24].

$$FL (\%) = N_p/N \times 100$$

Where N_p : Number of information claiming use of a plant species to treat a particular disease and N : Number of informants using the plant as a medicine to treat any given diseases.

Statistical analysis : Pearson correlation was performed to determine its association (strong or weak correlation) between two different variables on the use of natural medicines. Chi-square test (χ^2) and t test were performed to determine different demographic characters and the treatment used for infectious diseases. All the data were analyzed by using the Statistical Package for the Social Sciences (SPSS) version 16.0, Microsoft office Excel 2011 and a P value less than 0.01 and 0.05 were considered significant.

III. RESULTS

Characteristics of participants : Table 1 provides demographic information (gender, age cohort, educational status and profession) recorded from the 2,600 indigenous people of six different districts of Assam viz., Kamrup (M), Kamrup (R), Nalbari, Barpeta, Dhemaji and Lakhimpur. Three hundred males (60%) and two hundred females (40%) of Kamrup (M) district, two hundred eighty males (56%) and two hundred twenty females (44%) of Kamrup (R) district, two hundred sixty males (52%) and two hundred forty females (48%) of Nalbari district, two hundred thirty one males (46.2%) and two hundred sixtynine of females (53.8%) of Barpeta district, sixty males (60%) and forty females (40%) of Dhemaji district and three hundred twelve males (62.4%) and one hundred eighty eight females (37.6%) of Lakhimpur district were recruited during the field survey. The informants aged between 40-50 were observed to have the highest participation rate 19.6% in Kamrup (M), 29.8% in Kamrup (R), 39.2% Barpeta and 50% in Dhemaji district. But in Nalbari and Lakhimpur district the highest participation rate was in between the age group of 50-60, which were 28% and 33.6% respectively. The majority of the educational status of the total 2,600 informants having the secondary education was 34.8% in Kamrup (R), 37.8% Nalbari, 40% Dhemaji and 46.2% in Lakhimpur district. But in Kamrup (M) district the highest educational status were post secondary 33.8% and and in Barpeta it is primary education 38.8%.

Table 1. Socio-demographic characteristics of interviewee (n=2600) in Kamrup (M), Kamrup (R), Nalbari, Barpeta, Dhemaji and Lakhimpur districts

Variable	Categories	Frequency (n=500) Kamrup (M)	Frequency (n=500) Kamrup (R)	Frequency (n=500) Nalbari	Frequency (n=500) Barpeta	Frequency (n=100) Dhemaji	Frequency (n=500) Lakhimpur
Gender	Male	300 (60%)	280 (56%)	260 (52%)	231 (46.2%)	60 (60%)	312 (62.4%)
	Female	200 (40%)	220 (44%)	240 (48%)	269 (53.8%)	40 (40%)	188 (37.6%)
Age cohort	20-30	75 (15%)	69 (13.8%)	50 (10%)	30 (6%)	10 (10%)	40 (8%)
	30-40	78 (15.6%)	90 (18%)	40 (8%)	60 (12%)	20 (20%)	68 (13.6%)
	40-50	98 (19.6%)	149 (29.8%)	140 (28%)	196 (39.2%)	50 (50%)	168 (33.6%)
	50-60	94 (18.8%)	126 (25.2%)	168 (33.6%)	146 (29.2%)	7 (7%)	173 (34.6%)
	60-70	80 (16%)	16 (3.2%)	70 (14%)	40 (8%)	10 (10%)	30 (6%)
	70-80	65 (13%)	30 (6%)	20 (4%)	8 (1.6%)	1 (1%)	15 (3%)
	80-90	10 (2%)	20 (4%)	12 (2.4%)	20 (4%)	2 (2%)	6 (1.2%)
Education	No formal	96 (19.2%)	54 (10.8%)	80 (16%)	65 (13%)	5 (5%)	40 (8%)
	Primary	142 (28.4%)	164 (32.8%)	160 (32%)	194 (38.8%)	30 (30%)	169 (33.8%)
	Secondary	93 (18.6%)	174 (34.8%)	189 (37.8%)	189 (37.8%)	40 (40%)	231 (46.2%)
	Post secondary	169 (33.8%)	108 (21.6%)	71 (14.2%)	52 (10.4%)	25 (25%)	60 (12%)
Profession	Farmers	92 (18.4%)	133 (26.6%)	65 (13%)	83 (16.6%)	15 (15%)	30 (6%)
	Students	54 (10.8%)	69 (13.8%)	69 (13.8%)	81 (16.2%)	5 (5%)	25 (5%)
	Teachers	123 (24.6%)	134 (26.8%)	49 (9.8%)	142 (28.4%)	20 (20%)	42 (8.4%)
	others	231 (46.2%)	164 (32.8%)	317 (63.4%)	194 (38.8%)	60 (60%)	403 (80.6%)

In Table 2 it is seen that in Kamrup (M), Kamrup (R), Nalbari and Lakhimpur district the people in the age group of 50-60 use maximum natural medicine i.e. GP for recovery of GDs whereas the people of the age group 40-50 use maximum allopathic medicine. In case of Barpeta district the maximum people in the age group of 50-60 prefer allopathic medicine whereas the people in the age group of 40-50 prefer GP. In case of Dhemaji district maximum people in the age group of 40-50 prefer GP against 30-40 age group for allopathic medicine for treatment of GDs. Thus it is revealed that maximum number of people in the surveyed districts prefer GP than allopathic medicine for treatment of different kinds of GDs. Based on the χ^2 test, it was found that the age group had a significant ($p < 0.05$) impact on the type of treatment used.

Table 2. Relationship between different age groups and treatment used for GDs in surveyed districts

District	Age group	Treatment used Allopathic medicine	Treatment used Natural medicine	Total	χ^2 test
Kamrup (M)	20-30	20	55	75	P<0.05
	30-40	40	38	78	
	40-50	60	38	98	
	50-60	20	74	94	
	60-70	20	60	80	
	70-80	5	60	65	
	80-90	0	10	10	
Kamrup (R)	20-30	26	43	69	P<0.05
	30-40	33	57	90	
	40-50	59	90	149	
	50-60	35	91	126	
	60-70	0	16	16	
	70-80	0	30	30	
	80-90	0	20	20	
Nalbari	20-30	10	40	50	P<0.05
	30-40	10	30	40	
	40-50	70	70	140	
	50-60	20	148	168	
	60-70	10	60	70	
	70-80	2	18	20	
	80-90	0	12	12	
Barpeta	20-30	6	24	30	P<0.05
	30-40	24	36	60	
	40-50	30	166	196	
	50-60	42	104	146	
	60-70	0	40	40	
	70-80	0	8	8	
	80-90	3	17	20	
Dhemaji	20-30	1	9	10	P<0.05

	30-40	5	15	20	
	40-50	0	50	50	
	50-60	3	4	7	
	60-70	0	10	10	
	70-80	0	1	1	
	80-90	0	2	2	
Lakhimpur	20-30	8	32	40	P<005
	30-40	20	48	68	
	40-50	30	138	168	
	50-60	13	160	173	
	60-70	0	30	30	
	70-80	5	10	15	
	80-90	3	3	6	

Table 3. GP fruit used for different ailment categories based on FL (%) in each ailment category of

District	Botanical name	Total informants	Ailment categories	Citation for particular disease (use-report)	Fidelity level (FL) (%)
Kamrup (M)	GP	335	Dysentery	180	53.73
			Jaundice	55	16.41
			Diarrhea	100	29.85
Kamrup (R)	GP	347	Dysentery	165	47.55
			Jaundice	85	24.49
			Diarrhea	97	27.95
Nalbari	GP	378	Dysentery	189	50.0
			Jaundice	79	20.89
			Diarrhea	110	29.10
Barpeta	GP	395	Dysentery	169	42.78
			Jaundice	86	21.77
			Diarrhea	140	35.44
Dhemaji	GP	91	Dysentery	60	65.93
			Jaundice	20	21.97
			Diarrhea	11	12.08
Lakhimpur	GP	421	Dysentery	167	39.66
			Jaundice	139	33.01
			Diarrhea	115	27.31

Kamrup (M), Kamrup (R), Nalbari, Barpeta, Dhemaji and Lakhimpur districts.

Use of GP for treatment of different stomach related diseases in the surveyed districts : It is seen in Table 3 that GP has been using by the people for healing different stomach related disorders viz., dysentery, jaundice and diarrhea. Survey report revealed that 53.73% from Kamrup (M), 47.55% from Kamrup (R), 50% from Nalbari, 42.78% from Barpeta, 65.93% from Dhemaji and 39.66% from Lakhimpur district use GP for treatment of dysentery. Whereas for treatment of jaundice in Kamrup (M) district 16.41%, Kamrup (R) district 24.49%, Nalbari district 20.89%, Barpeta district 21.77%, Dhemaji district 21.97% and in Lakhimpur district 33.01% people use GP. Similarly 29.85%, 27.95%, 29.10%, 35.44%, 12.08% and 27.31% people use GP for treatment of diarrhea in Kamrup (M), Kamrup (R), Nalbari, Barpeta, Dhemaji and Lakhimpur district. Thus the average use of GP in the surveyed districts for the treatment of dysentery, jaundice and diarrhea are 49.94%, 23.09% and 26.95% respectively.

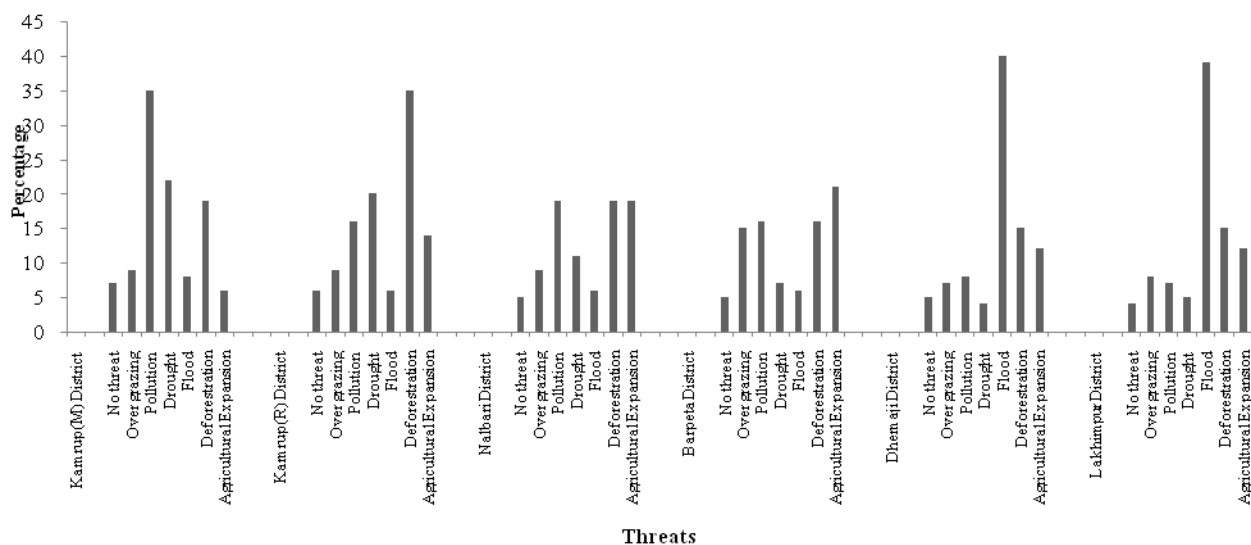
3.3 Availability of GP plant

Apart from the study made in the districts about the effects of using GP fruit as herbal medicine, emphasis is also laid to know about the significance, availability of GP plants in the study area.

Table 4. Association between significance and availability of garcinia plant, taste and effect (n=Number of participants)

Variables	n (%) (2600)	Significant
<u>Significance of plant</u>		
Social use	0	Significance of plant Availability of plant (P>0.01) (R ^{PC} , Pearson correlation) (No significant)
Edible use	2600 (100%)	
Religious use	0	
<u>Availability of plants</u>		
Easily available	2000 (76.92%)	
Not easily available	500 (19.23%)	
Not available	100 (3.84%)	
<u>Taste of GP fruit</u>		
Like	2300 (88.46%)	Taste of GP fruit Effect of GP fruit (P<0.01) (R ^{PC} , Pearson correlation) (Highly significant)
Neutral	250 (9.61%)	
Dislike	50 (19.2%)	
<u>Effect of GP fruit</u>		
Good	2400 (92.3%)	
Neutral	50 (1.92%)	
Fair	150 (5.76%)	

The GP plants are not found in abundance throughout Assam despite it has great medicinal value. There is no systematic and scientific plantation of the GP in Assam. However, according to the informants the GP plants are found easily available in the surveyed districts compared to the other parts of Assam. The significance and availability of GP plant in the surveyed districts are shown in Table 4.

**Figure 1. Threats to GP plant of the study area in six different districts of Assam**

The study also covered the various threats subjected to gradual cessation of the valuable tree as shown in Fig. 1. It revealed from the Fig. 1 that the cause of gradual decrease of the production of GP plant are different in different districts. For example, in Kamrup (M) district the cause of decrease of availability of GP plant is due to pollution affect whereas in Dhemaji and Lakhimpur district it is due to flood. On the other hand in Kamrup (R) district the major threat for the plant is the deforestation.

IV. DISCUSSION

The basic objective of the present study was to collect information regarding ethnomedical value of GP fruit used traditionally for the treatment of various stomach disorders. The information were collected on actual use and result derived by the informants. The study revealed that the people have been using the GP fruit not only for the medicinal purposes but also for consumption as food items, juice etc. According to the informants the mode of use of GP as medicinal value is different to that of normal consumption as food items. For medicinal purposes, the fruit is sliced into small pieces, and then dried under the direct sunlight about 10-15 days for preservation. The seeds are separated and discarded.

The processed product is known as 'Suthi' in Assamese. Healing value of the dried form of the fruit increases on the length of its preservation. The more it is old, the more it is effective. For using the GP as herbal medicine a known quantity of dried pulp is mixed with water and prepare a kind of juice. The juice is used as medicine while a person is suffering from different stomach related disorders. It appeared from the survey that gender is not a determining factor for the use of GP to be used as herbal medicine. The survey report revealed that the involvement of male persons were comparatively more than the females. It also appeared that the people between the average age of 50-60 persons covering both male and female were found to have used GP for treatment of GDs. The involvement of young age group were found comparatively lesser than the older age group persons. It is because the older person have more faith in the traditional medicines for recovering different kinds of diseases than the young persons. The participation of educated people and professionals have also significant impact on the use of GPs for treatment of GDs in rural areas. This is because the allopathic medicines are tend to be more expansive as compared to the conventional medicines. The another important reason for using conventional medicines was due to inaccessibility of pharmaceutical drugs in those areas. This was consistent with that of Adams et al. (2011a, 2011b) which showed that conventional beliefs were still persist in rural areas. In rural Assam most of the inhabitants suffer from GDs due to flood, drought, insanitation and lack of pure drinking water etc. As a result the rural people have been traditionally using herbal medicines for recovery of those diseases. During survey it was observed that majority of the rural people in Assam use GP as herbal medicine mainly for recovery of dysentery.

The study also revealed that fresh GP fruit is not consumed as food items or medicine as it causes blood dysentery. The survey report indicated that GP has been using traditionally by the people as a herbal medicine for health care in dried condition only. The access of allopathic medicines in the interior rural Assam is lacking behind and so people are compelled to use the traditional medicines for their immediate reliefs. Since majority of the samples of the study confided the medicinal value of the GP, the traditional treatment for healing GDs by using GP is significant. Considering the importance of GP fruit as herbal medicine, the conservation of the GP plant is equally important. Due to different social and environmental adversities the plant has been subjected to near extinction. As such it needs a specific strategy to increase the cultivation/plantation of the valuable plant on priority basis.

V. CONCLUSION

Study on the use of GP fruit for healing different kinds of GDs in different parts of Assam revealed that most of the rural inhabitants prefer to use GP fruit as a medicine for healing their different stomach related diseases rather than allopathic medicines. 2,600 data at random were collected from six different districts of Assam where 1,967 persons reportedly adopt GP for treatment of GDs like dysentery, jaundice and diarrhea etc. Most of the samples irrespective of their gender, age (above 18 years), educational and professional status adopt GP as a medicine for remedy and they consider it as a useful and healer medicine. Another interesting findings of this study was that 633 out of the 2,600 people adopt allopathic medicine for healing different stomach diseases which was highly significant ($P < 0.01$). Results from the survey revealed that maximum people under the age group of 40-50 and 50-60 use GP fruit for medicinal purposes. It was also found that maximum number of people who used GP as a medicinal plant were literate people ($P < 0.01$) and they prefer herbal medicines than allopathic medicine for healing different kind of GDs. It could also be known from the informants that they recovered different stomach related disorders by using GP and according to them it has no side affect too. Thus it is assumed that the importance of GP plant as well as its fruit has great relevance and medicinal value for healing different GDs. A detail and scientific study about this potential plant may able to discover a patent for medicine for the purposes of treatment of different kinds of stomach-related diseases.

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Appendix A (English Version)

(Proforma used for the field works)

Name.....
 Male/Female.....
 Age.....
 Village/Town.....
 District.....
 Educational qualification.....
 Profession.....

Question	Views
1. Do you consume GP ?	
2. Which GP do you like to consume ? <i>Garcinia pedunculata</i> (GP) or <i>Garcinia morella</i> (GM)	
3. Do you consume GP for recovery of any diseases?	
4. If so, for what ?	
5. Do you think that your disease is cured after consuming GP ?	
6. For recovery of disease which GP you are using ? Dried form of GP or Fresh GP	
7. According to you which GP is effective ? Cooked or Uncooked	
8. Do you think that to much consumption of GP may have	

adverse affect ?	
9. Do you use fresh GP for taste only ?	
10. Do you have GP plant at your homestead land ? If so what is the yearly productivity of fruits of the plant ?	
11. How do you preserve GP for consumption ?	
12. How many GP species you have seen? And what are those ?	
13. Seed of ripen GP can be consumed. What is your opinion ?	
14. Would you tell anything new about GP ?	