A study on food-medicine continuum among the non-institutionally trained 
siddha practitioners of Tiruvallur district, 
Tamil Nadu, India

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Abstract

Background: Medicinal properties of the food species are one of the poorly documented and important areas of ethnopharmacology. The present survey quantitatively documented the medicinal foods prescribed by the non-institutionally trained siddha practitioners of Tiruvallur district of Tamil Nadu.

Methods: Field work was carried out between December 2014 and April 2017 using a questionnaire. The illnesses mentioned by the informants were grouped as illness categories on the basis of emic perceptions. Sufficiency of sampling of this survey was assessed by plotting the cumulative number of UR and Shannon-Wiener’s index. The indices such as informant consensus factor (FIC), Index of Agreement on Remedies (IAR), and Cultural Food Significance Index (CFSI) were calculated.

Results: This study documented 165 medicinal foods used by 82 non-institutionally trained siddha practitioners of Tiruvallur district, and 73.93% of these preparations were plant based. Among the animal taxa, 82.05% were represented by fish taxa. The illness category gastrointestinal ailments is the majorly cited illness category treated with plant-based formulations. The illness categories viz., gastrointestinal ailments, hemorrhoids, and neural ailments had high consensus under the group of plant-based medicinal foods. In animal-based medicinal foods, kapha ailments had gained 23.07% of UR. The illness categories such as bone fractures, male reproductive ailments, blood ailments, and anabolic had high FIC values.

Conclusions: Deeper studies on different dietary cultures of India may help to derive better interpretations on food-medicine continuum. This study identified some important claims such as the use of citron, pomegranate and Solanum americanum (gastrointestinal ailments), Abutilon indicum, onions and elephant foot yam (hemorrhoids), Boerhavia diffusa (urinary ailments), Moringa oleifera (anemia), Aloe vera (gynecological ailments), Eclipta prostrata (liver ailments), ivy gourd (diabetes), citron (hypertension), Centella asiatica (psychological ailments), spade nose shark (lactogogue), reticulate whipray (wheezing and bronchitis), Katelysia opima (impotence), Indian squid (anemia), and Indian oil sardine (anabolic).

More studies on these claims will help identify novel functional foods to add to the field of medical nutrition therapy, with traditional brand identity. Robust studies on the documentation of the traditional knowledge on marine resources will yield a good database for various stakeholders and policy makers.

Keywords: Medicinal foods, Functional foods, Traditional brand identity, Indian traditional medicine

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Background
In many traditions, species which are used as medicine are also used as food and vice-versa; in many cases, ethnobiologists have documented this unclear delineation between food and medicine [1]. Ethnopharmacological surveys showed that the local people who gathered various wild species for food had knowledge about the health benefits of those species [2]. These health benefits go beyond from nutritional perspectives to health promoting phytochemicals [3] and many of them have been consumed by healthy people as a prophylactic measure. Local gastronomies are one of the important markers of regional identity and have been built upon various ecological, cultural, and religious beliefs [4]. Studies on the dietary patterns of a culture yield better clues on patterns of health and diseases observed in that population [5]. The importance of food-medicine interface in ethnopharmacology has been recognized for nearly 25 years [6, 7]. Many studies focused either on the dietary or pharmacological properties of the species and only limited studies addressed this food-medicine continuum [8].

India has a wide diversity of traditional cuisines; they contain whole grains, millets, wild gathered vegetables [9] and various spices for coloring, flavoring and preserving foods [10]. Besides cultural and religious beliefs, Indian cuisine was largely influenced by the principles of traditional medicinal systems. According to Indian philosophy, food was considered as the gift from god and it was classified into various categories [11]. The cuisine of Tamils is one of the important and oldest cuisine systems of India, and it is influenced largely by siddha system of traditional medicine [12]. The sangam (300BC–300AD) and post-sangam age (300–600AD) literatures such as tirukku a, pattupāṭṭu, and acicarrakovai describe various types foods and rules for eating. A classical siddha literature, patārtha kuṇa cintāmaṇi, describes the medicinal properties of various foods and drinks [13].

Diet diversification is one of the concepts to combat micronutrient malnutrition and to prevent chronic diseases [14, 15]. Various factors such as increasing healthcare costs, life expectancy, and desire for improving the quality of life among elders created a demand in global food industry to find novel foods with functional properties [16]. Globally, a significant increase in the consumption of functional foods for prevention and management of various chronic ailments was recorded. The market size of functional foods is expected to grow by 241 billion US$ by 2019. In India, the functional food industry is expected to grow by 20% and to reach a market size of 6.1 billion rupees by 2019–2020. Traditional diets are generally considered as holistic, healthy, and medicinal; thus, the demand and public interest on such foods are increasing rapidly, as in the case of herbal drugs [17]. Developing functional foods from traditional claims has been considered as an area for identifying novel functional foods [18]. In countries like India where traditional medicinal systems are looked with a nationalistic sentiment, the demand and the scope for functional foods with traditional brand identity are increasing. Besides these advantages, previous studies also demonstrated the adverse interactions of some functional foods with conventional therapies [19, 20]. In such scenario, it becomes important to document and inclusively evaluate the nutritional as well as functional properties of medicinal foods used locally and also to know the illnesses generally treated with these foods [8].

Siddha is one of the major traditional medical systems of India, which shares some commonalities with āyurveda. It has been majorly practiced in Tamil Nadu state and in its fringes; it has also been practiced in foreign countries such as Sri Lanka and Malaysia by Tamil people [21]. Previous studies indicated that the siddha literatures used in contemporary practice started from fourth to fifth century AD, though the practices emerged earlier [22]. The name siddha had also been coined recently in 1923 to delineate it from other systems of traditional medicines [23]. Literatures related to siddha are found exclusively in Tamil language as palm leaf manuscripts, and many of them remain undocumented. Institutional training on siddha system of medicine has been provided by the Government of India; however, the number of non-institutionally trained practitioners remains high [24]. Non-institutional training in siddha system of medicine is usually given from father to son and master to disciple forms [23]. This kind of knowledge transmission is usually done orally, and a lot of their recipes remain undocumented. Our previous survey in this area documented the medicinal plants used for the treatment of cardiometabolic diseases by non-institutionally trained siddha practitioners [25], and this survey aimed to document and analyze the medicinal foods prescribed by the non-institutionally trained siddha practitioners for prevention or management of various illnesses.

Methods

Study area
Tiruullur district is located in the northern part of Tamil Nadu state between 12°15’–13°15’ N and 79°15’–80°20’ E, with an area of 3423 km² (Fig. 1). The eastern part of this district is bounded by the Bay of Bengal, and the remaining parts are mostly flat and dry. The coastal part of this district occupies 498 km² and has a costal line of 80 km for marine fisheries. The inland fresh water area is 750 km², and brackish water area is 148 km². This district has a forest cover of 197.8 km² which occupies 5.8% of the total area; these forests mostly fall under the classes of dry thorn and dry evergreen. This district has nine taluks (sub-districts) and 14 revenue blocks. This district exhibits both urban and rural characteristics. Nearly 47% of the total human workforce deals with agriculture; this district is one of the fastest developing districts of Tamil Nadu in
terms of industries. The average rainfall of the district is 1104 mm, out of which 52% is received from northeast monsoon and 41% is received from southwest monsoon. The State Government is providing siddha treatment in 12 hospitals with 37 institutionally trained siddha practitioners.

**Interviews**

The local knowledge of non-institutionally trained siddha practitioners on medicinal foods was documented between December 2014 and April 2017 using a questionnaire. The interview protocols used for this survey were in accordance with the previously published methods [26–29] and also with the guidelines of ISE code of ethics for ethnobiological research [30]. This study focused on the local knowledge of siddha practitioners who learnt only through traditional methods of teaching (non-institutional training), practicing for a minimum of 5 years, and willing to share their knowledge. Snowball sampling method was used to recruit the informants, and the informants for this survey were recruited irrespective of age, gender, education, and nativity. The aim of this survey was explained to the participants in lay terms: one or two visits were taken to get familiarity, and the formal interviews were conducted after getting written informant consent to participate in this survey. By this way, the local knowledge of 82 non-institutionally trained siddha practitioners on medicinal foods was documented in this communication. The protocol used in this survey was approved by the Institutional Ethics Committee for Ethnobiological Research.

The questionnaire used for this survey consisted of two parts. In the first part, the data related to the demography of the informants such as age, gender, education, mode of learning traditional medicine, experience, nativity, residential area, and occupation were documented. In the second part of the questionnaire, the data regarding the medicinal foods that they are prescribing to their patients, the ingredients (plants/animals) used to prepare these foods, parts, mode of preparation, illnesses treated with these foods, dosage, and duration of consumption were documented. Under the ingredients section, the key medicinal taxa which were perceived to attribute the medicinal effect were
also documented. Besides it, other details such as the perceived availability of resources (very common - rare), localization of the usage (ubiquity - rare), frequency of usage (frequent - no longer used), parts used, multi-functional usage (different eatable forms reported), taste score (best - terrible), and medicinal role (very high - not recognized) were also documented. The informants were taken to the fields from where they usually collected the samples, including local markets, and asked to show the specimens of the taxa that they mentioned either fresh or in dry condition. The interviews were conducted in the local language Tamil, and they were video-graphed. Questionnaires were cross-verified with the video-graphs for ambiguous entries. The data were translated into English in the laboratory. Equivalent English terms for the illnesses were fixed by correlating the Tamil terminologies and symptoms with the biomedical literature by consulting an institutionally trained siddha practitioner.

Specimens
Representative specimens of the fresh plants or crude drugs were collected, herborized, and stored at the museum of Entomology Research Institute, Loyola College, Chennai. The botanical authenticity of the plants was confirmed by the examination of the voucher specimens using local flora [31–34], and the valid names were confirmed with a website [35]. All the animals mentioned in this work were photographed, and their zoological names were confirmed by the Zoologist (MGP), who is one of the authors of this communication.

Quantification of the data
Medicinal plants/animals which were considered as key medicinal taxa by the informants were taken for the analysis. The illnesses mentioned by the informants were grouped as illness categories on the basis of enic perceptions. The illness category vadha ailments include the musculoskeletal disorders and kapha ailments include the pulmonary and respiratory diseases. The data were then converted into use reports (UR) and claims in accordance with our previous work. Briefly, UR can be described as “informant (i) prescribes a species (s) for a use category (u)” [36]; claims lack the informant (i) factor [37]. For example, if two informants mention a species for the treatment of an illness category, it yields two UR and a claim. Sufficiency of sampling of this survey was assessed by plotting the cumulative number of UR and Shannon Wiener’s index, which was calculated using PAST3 program.

Informant consensus over treating illnesses and on the taxa was assessed using informant consensus factor (FIC) and Index of Agreement on Remedies (IAR), respectively, [38] using the following formula.

\[ \text{FIC} = \frac{(N_{ur} - N_s)}{(N_{ur} - 1)} \]

\[ \text{IAR} = \frac{(n_{ur} - n_d)}{(n_r - 1)} \]

where \( N_{ur} \) is the number of UR for a particular illness category, \( N_r \) is the total number of taxa mentioned for that particular illness category, \( n_{ur} \) is the total number of UR registered for a taxon, and \( n_d \) is the number of illness categories that are treated with that taxon. These factors range from zero to one, where increasing values indicate high rate of informant consensus. Illness categories with high, average, and low consensus were calculated [39, 40]. Local uses of medicinal taxa having high IAR value and UR were compared with global usage pattern and scientific literature.

Humoral properties (cold and hot) of the medicinal plants and their uses in formal siddha medicine were taken from siddha materia medica [41–44]. If no report was available about a taxon, it was kept under the category “unspecified.” relative frequency of citation (RFC) on the basis of humors for each illness category was calculated using the following formula.

\[ \text{RFC} = \frac{\text{number of UR for a humor}}{\text{total number of UR}} \times 100 \]

Cultural Food Significance Index (CFSI) of the key medicinal taxa was calculated in accordance with the method of Pieroni [45] with slight modifications (Table 1). For this calculation, key medicinal taxa with a minimum of two UR were considered. CFSI took seven indices into account, and it was calculated using the following formula.

\[ \text{CFSI} = (QI \times AI \times FUI \times PUI \times MFFI \times TSAl) \times FMRI \times 10^{-2} \]

where Quotation index (QI) indicated the number of UR for a taxon. Availability index (AI) was obtained by subtracting scores of localization of the use from the scores of availability. Frequency of use index (FUI), part used index (PUI), multifunctional food use index (MFFI), Taste Score Appreciation Index (TSAl), and Food Medicinal Role Index (FMRI) were calculated as given in Table 1. In the case of FMRI, the taxa with IAR greater than mean plus standard deviation of the IAR of all taxa were given the highest score. The taxa with IAR value lower than mean plus standard deviation of the IAR were given the lowest score. Other taxa were given average FMRI score. For animal taxa, PUI was omitted from calculation.

Results
Demographic profile of the informants
Analysis of the informants’ demography indicated that the non-institutionally trained siddha tradition is a male dominant domain and a major portion of these practitioners had completed secondary or higher secondary schooling. Considerable portion (36.58%) of the practitioners had migrated to the study area from other districts. It also showed...
that major portion (71.94%) of practitioners was practicing in urban and semi-urban areas (Table 2).

Descriptive statistics of the medicinal foods
This study documented 165 medicinal foods used by the non-institutionally trained *siddha* practitioners of Tiruullur district to treat various illnesses. Among them 73.93% were plant based, and 26.07% foods used animal taxa as the major key ingredients. To prepare these foods, 104 (72.72%) plant taxa and 39 (27.27%) animal taxa were used and major portion of the animals was represented by fish taxa. Sampling sufficiency analysis showed a clear asymptote of the curve which indicated the sufficiency of the sampling (Fig. 2). Analysis of the data yielded 588 UR and 381 claims. Plant-based formulations gained high number of UR (77.68%) and claims (76.64%). The plant and animal taxa cited by the non-institutionally trained *siddha* practitioners are given in Tables 3 and 4. The medicinal foods prescribed by the informants are given in Additional file 1: Table S1. The photographs of some animal taxa referred by the informants for the preparation of medicinal foods are given in Fig. 3.

Consensus over the use of plant-based medicinal foods
The illness categories viz., gastrointestinal ailments, hemorrhoids, and neural ailments were considered as illness categories with high consensus since they had higher FIC values than mean plus average FIC value. Sixteen illness categories such as *kapha* ailments, weakness, urinary, and ailments had average FIC values and were considered as illness categories with average consensus. Eight illness categories such as bone fractures, fatigue, fever, headache, hypotension, hypothyroidism, jaundice, and obesity were considered as illness categories with low consensus (Table 5).

Consensus over the use of animal-based medicinal foods
Among the illness categories treated with animal-based medicinal foods, *kapha* ailments had gained high percentage (23.07%) of UR followed by gynecological ailments (14.61%). Nineteen illness categories were reported to be treated with animal-based medicinal foods. Analysis of the consensus showed that the categories viz., bone fractures, male reproductive ailments, blood ailments, and anabolic had high FIC values and were considered as illness categories with high consensus. Seven illness categories such as gynecological, urinary ailments, *kapha* ailments, fatigue, *vada* ailments, coolants, and fever were grouped as illness categories with average consensus (Table 5).

Illness categories treated with plant-based medicinal foods having high consensus
These two illness categories had high FIC scores among the illness categories treated with plant-based medicinal foods. Gastrointestinal ailment is the majorly cited illness category that represented 19.73% of total UR. In this category, 36 plant taxa were used to prepare the medicinal formulations. Among them, 26 taxa had a minimum of two UR for treating gastrointestinal ailments.

### Table 1 Scores for Cultural Food Significance Index

| Indices | Attributes | Scores |
|---------|------------|--------|
| Availability index (AI) | Availability | |
| Very common | 4.0 |
| Common | 3.0 |
| Middle | 2.0 |
| Rare | 1.0 |
| Localization of the use | Ubiquity | 0.0 |
| Localized | −0.5 |
| Very localized | −1.0 |
| Frequency of utilization index (FUI) | > Once/week | 5.0 |
| Once/week | 4.0 |
| Once/month | 3.0 |
| > Once/year but < once/month | 2.0 |
| Once/year | 1.0 |
| No longer used during the past 30 years | 0.5 |
| Part used index (PUI) | Whole aerial parts | 3.0 |
| Leaves with a few stems, whole aerial parts of very young plants | 2.0 |
| Root/root stocks, bulbs, leaves, fruits | 1.5 |
| Shoots | 1.25 |
| Bark, younger part of roots, stems, leaf stalks, young whorls of leaves, seeds | 1.0 |
| Younger part of shoots, buds, flowers, receptacles | 0.75 |
| Multifunctional food use index (MFFI) | Chutney, dosa, gravy, sauce, salad | 1.5 |
| Jam, porridge, pickles, fried, syrups | 1.0 |
| Soup, milk preparation | 0.75 |
| Raw | 0.5 |
| Taste Score Appreciation Index (TSAI) | Best | 10.0 |
| Very good | 9.0 |
| Good | 7.5 |
| Fair | 6.5 |
| Poor | 5.5 |
| Terrible | 4.0 |
| Food Medicinal Role Index (FMRI) | IAR of the taxa > mean + SD | 5.0 |
| IAR of the taxa < mean + SD but IAR > mean − SD | 4.0 |
| IAR < mean − SD | 3.0 |

# Additional Information

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The taxa such as fruits of *Citrus medica* (citron), leaves, unripe fruits of *Coccinia grandis* (ivy gourd), and flowers of *Musa paradisiaca* (plantain) had high number of UR.

In the case of hemorrhoids, eight plant taxa were used; among them, six taxa had a minimum of two UR. In this category, *Allium cepa* (onion), *Abutilon indicum*, *Amorphophallus paeoniifolius* (elephant foot yam), and plantain had high number of UR and IAR values. In the case of neural ailments, *Solanum americanum* had high number of UR and was reported to strengthen the nerves (Table 6).

**Illness categories treated with plant-based medicinal foods having average consensus**

*Kapha* (pulmonary and respiratory) ailments gained 7.01% of total UR and 17 taxa. In this category, *Mukia maderaspatana* had high IAR score and UR. In the case of general weakness, the flour of *Vigna mungo* seeds (black gram) had high number of UR. The use of *Boerhavia diffusa* leaves had high UR to treat urinary ailments. The leaves of *Moringa oleifera* scored high UR under the category of blood ailments for the treatment of anemia. The gel of *Aloe vera* had high UR under the category of gynecological ailments and given to treat general ailments of uterus, dysmenorrhea, and metrorrhagia. In this category, the flowers and tender fruits of plantain had a high IAR score.

Cooked leaves of *Eclipta prostrata* were given to treat the liver ailments, and it had high number of UR in this category. In the case of diabetes, the plants such as stems of *Brassica oleracea* var. *gongylodes* (kohlrabi) and the fruits of *Syzygium cumini* had high IAR score. In this category, the leaves and fruits of ivy gourd had high number of UR. The fruits such as mango and citron had high number of UR and IAR score under the category of heart ailments. In the case of male reproductive ailments, the leaves

| Table 2 Demographic profile of the informants interviewed in the survey (N = 82) |
|-----------------------------------------------|
| Age | Number | Percent |
| 35–40 | 7 | 8.53 |
| 41–50 | 44 | 53.65 |
| 51–60 | 26 | 31.70 |
| Above 60 | 5 | 6.09 |
| Gender | | |
| Male | 80 | 97.56 |
| Female | 2 | 2.43 |
| Education | | |
| Primary school | 5 | 6.09 |
| Secondary school | 20 | 24.39 |
| Higher secondary | 41 | 50.00 |
| Degree | 16 | 19.51 |
| Mode of learning | | |
| From family members | 13 | 15.85 |
| From traditional practitioners | 69 | 62.19 |
| Experience | | |
| 5 years | 1 | 1.21 |
| 6–20 years | 62 | 75.60 |
| 21–50 years | 19 | 23.17 |
| Nativity to the district | | |
| Native | 52 | 63.41 |
| Migrated | 30 | 36.58 |
| Residence | | |
| Urban | 35 | 42.68 |
| Semi-urban | 24 | 29.26 |
| Rural | 23 | 28.04 |
| Occupation | | |
| Full time practitioners | 82 | 100 |

Fig. 2 Assessing sampling sufficiency for the plant and animal species cited to prepare medicinal foods by the non-institutionally trained *Siddha* practitioners in Tiruvallur district using Species Accumulation Curve
| S.No | Binomial name, Voucher number | Vernacular name | Parts used | Humoral property | Reported pharmacological action in Siddha | Illnesses treated | Illnesses categories | IAR |
|------|-------------------------------|----------------|------------|------------------|------------------------------------------|-------------------|---------------------|-----|
| 1.   | Abelmoschus esculentus (L.) Moench SE201 (Malvaceae) | Venṭaikkāy | Tender fruits | Cold | Refrigerant, Aphrodisiac, Demulcent, Diuretic, Emollient, To treat diarrhea and dysentery | Diabetes (2), Coolant (1), Oligospermia (1) | Dia. (2), Coo. (1), Mal. (1) | 0.333 |
| 2.   | Abutilon indicum (Link) Sweet SE193 (Malvaceae) | Tutti | Leaves | Cold | Demulcent, Tonic, Laxative, Diuretic, Sedative, To treat hemorrhoids, boils, gangrene and warts | Hemorrhoids (3) | Hem. (3) | 1.000 |
| 3.   | Acalypha indica L. SE188 (Euphorbiaceae) | Kuppaimē i | Leaves | Hot | Anodyne, Anthelmintic, Cathartic, Diuretic, Emetic, Expectorant, Emmenagogue, To treat toothache, burns, organic poisons, stomachache, hemorrhoids, joint pain and bronchitis | Bronchitis (1), Hemorrhoids (2), Intestinal worms (1) | Hem. (2), Kap. (1), Gas. (1) | 0.333 |
| 4.   | Allium cepa L. SE170 (Amaryllidaceae) | Veṅkāyam | Bulbs | Hot | Stimulant, Diuretic, Expectorant, Emmenagogue, Rubefacient, Demulcent, Aphrodisiac, To treat hemorrhoids, eczema, hypertension, mouth ulcers, polydipsia and diarrhea | Hemorrhoids (1), Bleeding through rectum (3), Oligospermia (2), Burning sensation (1) | Hem. (4), Mal. (2), Coo. (1) | 0.666 |
| 5.   | Allium sativum L. SE107 (Amaryllidaceae) | Ve aippūṇṭu | Bulbs | Hot | Carminative, Stomahic, Tonic, Alternative, Stimulant, Expectorant, Diuretic, Anthelmintic, To treat boils, cough, wheezing, intestinal worms and hemorrhoids | Indigestion (1), Dysmenorrhea (1), Diabetes (1), Heart ailments (1), Flatulence (1) | Gas. (2), Gyn. (1), Dia. (1), Hea. (1) | 0.250 |
| 6.   | Aloe vera (L.) Burm.f. SE108 (Asphodelaceae) | Ka ā ai | Leaves | Cold | Tonic, Alternative, Purgative, Emmenagogue, To treat dermatological ailments, leprosy, hemorrhoids, anal fistula, calculi | Obesity (1), Urolithiasis (1), Liver ailments (1), Dysmenorrhea (2), Metrorrhagia (1), Uteral ailments (1), Gastrointestinal ailments (1) | Gyn. (4), Obe. (1), Uri. (1), Liv. (1), Gas. (1) | 0.428 |
| 7.   | Alternanthera sessilis (L.) R.Br. ex DC. SE159 (Amaranthaceae) | Po āṅkāṇṇi | Leaves | Cold | Alternative, Coolant, Good for eyes | Menstrual migraine (1), To increase memory and vision (1) | Gyn. (1), Psy. (1), Eye. (1) | 0.000 |
| 8.   | Amaranthus viridis L. SE117 (Amaranthaceae) | Aaikkiraḷ | Leaves | Hot | Stimulant, Aphrodisiac | Male infertility (1), Anemia (1), General weakness (2) | Wea. (2), Mal. (1), Blo. (1) | 0.333 |
| 9.   | Amorpha phyllus paecinillius (Dennst.) Nicolai SE113 (Araceae) | Karuṇāikkī ahkū | Rhizomes | Cold | Alternative, Nutritive, Tonic, To treat pulmonary ailments, Hemorrhoids and anorexia | Hemorrhoids (3), Hypertension (1) | Hem. (3), Hpt. (1) | 0.666 |
| S.No | Binomial name, Voucher number & Family | Vernacular name | Parts used | Humoral property<sup>a</sup> | Reported pharmacological action in <i>Siddha</i><sup>b</sup> | Illnesses treated | Illnesses categories | IAR |
|------|--------------------------------------|----------------|------------|-----------------------------|------------------------------------------------|------------------|----------------------|-----|
| 10.  | Anacardium occidentale L. SE127 (Anacardiaceae) | Muntiri | Seeds | Cold | Tonic, Aphrodisiac | General weakness (2), Fatigue (1) | Wea. (2), Fat. (1) | 0.500 |
| 11.  | Annona squamosa L. SE183 (Annonaceae) | Citāppa am | Fruits | Cold | Coolant | Coolant (1), Gastric ulcers (1) | Coo. (1), Gas. (1) | 0.000 |
| 12.  | Arachis hypogaea L. SE126 (Fabaceae) | Vērkkatālai | Seeds | Hot | Nutrient, laxative, Emollient | General weakness (2), Fatigue (1) | Wea. (2), Fat. (1) | 0.500 |
| 13.  | Benincasa hispida (Thunb.) Cogn. SE200 (Cucurbitaceae) | Venpūcaṇi | Tender fruits | Cold | Diuretic, Styptic, Tonic, Alterative, Nutrient, To treat dysuria, fever, dermatological ailments, leucorrhoea, psychological ailments | Dysuria (1), To gain weight (1) | Uri. (1), Wea. (1) | 0.000 |
| 14.  | Beta vulgaris L. SE150 (Amaranthaceae) | Pīṭrūṭ | Rhizomes | – | – | Anemia (2), Male infertility (1), Hypotension (1) | Blo. (2), Mal. (1), Hpo. (1) | 0.333 |
| 15.  | Boerhavia diffusa L. SE194 (Nyctaginaceae) | Mākkkraṭṭai | Leaves | Hot | Expectorant, Diuretic, Laxative, Coolant, Anthelmintic, Emetic | Dysuria (3) | Uri. (3) | 1.000 |
| 16.  | Borassus flabellifer L. SE168 (Arecaceae) | Pa ai | Inflorescence | Cold | Coolant, Diuretic | Burning sensation (3), Jaundice (1) | Coo. (3), Jau. (1) | 0.666 |
| 17.  | Brassica oleracea var. gongylodes L. SE199 Brassicaceae | Nūkkal | Stems | – | – | Diabetes (2) | Dia. (2) | 1.000 |
| 18.  | Cardiospermum halicacabum L. SE109 (Sapindaceae) | Mutakkottā | Leaves | Hot | Diuretic, Laxative, Stomachic, Rubefacient, Antiinflammatory, Nutritive, To treat musculo-skeletal and dermatological ailments | Rhinitis (1), Cough (1), Somatalgia (3) | Ana. (3), Kap. (2) | 0.750 |
| 19.  | Carica papaya L. SE182 (Caricaceae) | Pappā i | Fruits | Hot | Laxative, Tonic, Diuretic, Lactogogue | Constipation (1), Lactogogue (1), Joint pain (1) | Gas. (1), Gyn. (1), Vad. (1) | 0.000 |
| 20.  | Cassia fistula L. SE197 (Fabaceae) | Carakko ai | Flowers | Hot | Vermifuge, To treat leucorrhoea, anemia, jaundice, dermatological infections and diabetes | Diabetes (1) | Dia. (1) | 0.000 |
| 21.  | Centella asiatica (L.) Urban SE157 (Apiaceae) | Vāllārai | Leaves | Cold | Alterative, Tonic, Diuretic, Stimulant, Emmenagogue, To treat fever, elephantiasis, scrotal swelling, Swollen lymph nodes, eczema, wounds and swellings | To strengthen memory (2), Hypothyroidism (1) | Psy. (2), Thy. (1) | 0.500 |
| S.No | Binomial name, Voucher number & Family | Vernacular name | Parts used | Humoral property<sup>a</sup> | Reported pharmacological action in Siddha<sup>b</sup> | Illnesses treated | Illnesses categories | IAR |
|------|--------------------------------------|-----------------|------------|-----------------------------|--------------------------------------------------|------------------|-------------------|-----|
| 22.  | Cicer arietinum L. SE129 (Fabaceae)   | Koṇṭaikkalai    | Seeds      | Cold                        | Antibilious, Diuretic, Aphrodisiac                 | General weakness (2), Fatigue (1), Menstrual cramps (1) | Wea. (2), Fat. (1), Gyn. (1) | 0.333 |
| 23.  | Cichorium intybus L. SE176 (Asteraceae) | Kāci ikkīrai   | Leaves     | –                           | –                                                 | Male infertility (1) | Mal. (1)         | 0.000 |
| 24.  | Cissus quadrangularis L. SE137 (Vitaceae) | Piranṭai       | Stem       | Hot                        | Alterative, Emmenagogue, Stomachic, To treat hemorrhoids, anorexia, ulcers, diarrhea and fatigue | Obesity (1), Gastric ulcers (1), Bone fractures (1), Hemorrhoids (3) | Hem. (3), Obe. (1), Gas. (1), Bon. (1) | 0.400 |
| 25.  | Citrus lanatus (Thunb.) Matsum. & Nakai SE178 (Cucurbitaceae) | Tarpūcaṇi      | Fruits     | Cold                       | Coolant, Diuretic                                  | Hyperacidity (2), Dysuria (1) | Gas. (2), Uri. (1) | 0.500 |
| 26.  | Citrus limon (L.) Osbeck SE167 (Rutaceae) | Elumiccai      | Fruits     | Hot                        | Carminative, Rubefaciency, To treat fainting, nausea, polydipsia, psychological ailments, eye ailments | Indigestion (3), Constipation (1), Heart ailments (1), Acne (1), Diabetes (1), Arthritis (2), To increase vision (1), Hypothyroidism (1) | Gas. (4), Vad. (2), Hea. (1), Der. (1), Dia. (1), Eye. (1), Thy. (1) | 0.400 |
| 27.  | Citrus medica L. SE184 (Rutaceae)     | Nārattai       | Fruits     | Cold                       | Aromatic, Stomachic, Astringent, Sedative, Digestive, Good to treat hypertension | Hyperacidity (1), Heart ailments (2), Gastric ulcers (2), Hypertension (2), Anorexia (2), Dermatological ailments (1) | Gas. (5), Hea. (2), Hpt. (2), Der. (1) | 0.666 |
| 28.  | Citrus reticulata Blanco SE185 (Rutaceae) | Akaṇcu        | Fruits     | –                          | –                                                 | Heart ailments (1) | Hea. (1)         | 0.000 |
| 29.  | Goeone gynandra L SE190 (Coccoaceae)  | Nolla ve al    | Leaves     | Hot                        | Rubešacient, Anthelmintic, Antispasmodic, Carminative, Diaphoretic | Joint pain (1), Rhinitis (2), Fever (1), Heart ailments (1) | Kap. (2), Fev. (1), Vad. (1), Hea. (1) | 0.250 |
| 30.  | Coccinia grandis (L.) Voigt SE147 (Cucurbitaceae) | Kövaikkāy     | Tender fruits | Cold                     | Esperatorant, Antispasmodic, Fibrifuge, To treat anorexia, fever, bronchitis and eczema | Gastric ulcers (3), Mouth ulcers (2), Oliguria (1), Diabetes (5), Burning sensation (2), Bronchitis (1) | Gas. (5), Dia. (5), Coo. (2), Uri. (1), Kap. (1) | 0.692 |
| 31.  | Cocculus hirsutus (L.) Diels SE139 (Menispermaceae) | Kaṭṭukkaṭi    | Leaves     | Hot                        | Alterative, Laxative, Demulcent, Coolant, To treat diarrhea, metrorrhagia, dysuria and gastric ulcers | Oligospermia (1), Coolant (1) | Mal. (1), Coo. (1) | 0.000 |
| 32.  | Cocos nucifera L. SE154 (Areaceae)    | Tēhkāy        | Endosperm  | Cold                       | Coolant, Aperient, Nutrient, Diuretic, To treat mouth ulcers | Male infertility (1), Hypotension (1), Gastric ulcers (1), Mouth ulcers (1) | Gas. (2), Mal. (1), Hpo. (1) | 0.333 |
| S.No | Binomial name, Voucher number & Family | Vernacular name  | Parts used | Humoral property | Reported pharmacological action in Siddha | Illnesses treated | Illnesses categories | IAR |
|------|--------------------------------------|-----------------|------------|------------------|------------------------------------------|-------------------|----------------------|-----|
| 33.  | *Cucumis sativus* L. SE174 (Cucurbitaceae) | Ve anikkōy | Tender fruits | Cold | Diuretic, Nutrient, Demulcent, Coolant | Hyperacidity (2) | Gas. (2) | 0.000 |
| 34.  | *Cuminum cyminum* L. SE134 (Apiaceae) | Cīrakam | Seeds | Cold | Carminative, Stimulant, Stomachic, Astringent, To treat hypertension, liver ailments, urolithiasis, dysentery, wheezing, rhinitis, insomnia | Somatalgia (1), Anemia (1), Anorexia (1), Coolant (2), Hypertension (1), Gastric ulcers (2) | Gas. (3), Coo. (2), Ana. (1), Blo. (1), Hpt. (1) | 0.428 |
| 35.  | *Daucus carota* L. SE153 (Apiaceae) | Kāraṭ | Rhizome | – | – | Male infertility (1), Hypotension (1), Bloating (1), Nausea (1) | Gas. (2), Mal. (1), Hpo. (1) | 0.333 |
| 36.  | *Digera muricata* (L.) Mart. SE192 (Amaranthaceae) | Toyakkīrai | Leaves | Coolant | Diarrhea (1), Dysentery (1) | | |
| 37.  | *Echinochloa frumentacea* Link SE123 (Poaceae) | Kūtiraivāli | Seeds | – | – | General weakness (2), Fatigue (1) | Wea. (2), Fat. (1) | 0.500 |
| 38.  | *Eclipta prostrata* (L.) L. SE177 (Asteraceae) | Karicalāñkannī | Leaves | Hot | Cholagogue, Tonic, Alterative, Emetic, Laxative, Deobstruent, Hepatoprotective, To treat throat ailments, jaundice, leprosy, ascites, anemia and toothache | To increase memory (1) and vision (1), Liver ailments (2), Anemia (2) | Liv. (2), Blo. (2), Psy. (1), Eye. (1) | 0.400 |
| 39.  | *Eclipta prostrata* Gaertn. SE118 (Poaceae) | Kē varaṇku | Seeds | Cold | Nutrient, Astringent, To treat diabetes | General weakness (2), Fatigue (1), Diabetes (1), To strengthen memory (1), Anemia (2) | Wea. (2), Blo. (2), Fat. (1), Dia. (1), Psy. (1) | 0.333 |
| 40.  | *Erythrina variegata* L. SE138 (Fabaceae) | Kalyāṇamuruñkai | Leaves | Hot | Diuretic, Laxative, Emmenagogue, Lactogogue | Bronchitis (1) | Kap. (1) | 0.000 |
| 41.  | *Ficus assa-foetida* L. SE136 (Apiaceae) | Perūhkāyum | Resin | Hot | Stimulant, Carminative, Antispasmodic, Expectorant, Laxative, Anthelmintic, Diuretic, Aphrodisiac, Emmenagogue | Somatalgia (1) | Ana. (1) | 0.000 |
| 42.  | *Ficus religiosa* L. SE141 (Moraceae) | Āl | Fruits | Cold | Astringent, Tonic, Aphrodisiac | Oligospermia (1) | Mal. (1) | 0.000 |
| 43.  | *Ficus racemosa* L. SE140 (Moraceae) | Atti | Fruits | Cold | Astringent, Laxative, Good to treat diarrhea, hemorrhoids and anemia | Oligospermia (1), Anemia (2), Male infertility (1), Constipation (1), Wheezing (1), Gastric ulcers (1), Hemorrhoids (1) | Mal. (2), Blo. (2), Gas. (2), Hem. (1), Kap. (1) | 0.428 |
| 44.  | *Ficus religiosa* L. SE141 (Moraceae) | Aracu | Fruits | Cold | Laxative, Coolant | Oligospermia (1) | Mal. (1) | 0.000 |
| S.No | Binomial name, Voucher number & Family | Vernacular name | Parts used | Humoral property | Reported pharmacological action in Siddha | Illnesses treated | Illnesses categories | IAR |
|------|--------------------------------------|----------------|------------|------------------|------------------------------------------|------------------|---------------------|-----|
| 45.  | *Foeniculum vulgare* Mill. SE114 (Apiaceae) | Peruñcīrakam | Seeds | Hot | Carminative, Stomachic, To treat uterine ailments, fever, indigestion, bloating, cough, liver ailments, wheezing, rhinitis | Heart ailments (1) | Hea. (1) | 0.000 |
| 46.  | *Garcinia gummi-gutta* (L.) Roxb. SE101 (Clusiaceae) | Koṭampun i | Fruits | Hot | Carminative, Digestive | Obesity (1) | Obe. (1) | 0.000 |
| 47.  | *Gossypium* spp. SE169 (Malvaceae) | Parutti | Seeds | Hot | Laxative, Expectorant, Aphrodisiac | General weakness (1), Somatalgia (1) | Wea. (1), Ana. (1) | 0.000 |
| 48.  | *Hibiscus cannabinus* L. SE202 (Malvaceae) | Pu icckārī | Leaves | Hot | Emollient, Laxative, To treat anorexia and hypertension | Anorexia (1) | Gas. (1) | 0.000 |
| 49.  | *Hibiscus rosa-sinensis* L. SE102 (Malvaceae) | Cemparattai | Flowers | Cold | Laxative, Aphrodisiac, Emmenagogue, Emollient, Demulcent, Coolant, To treat leucorrhea, metrorrhagia and hypertension | Male infertility (1), Heart ailments (2) | Hea. (2), Mal. (1) | 0.500 |
| 50.  | *Hybanthus enneaspermus* (G.Don) R.Br. ex Arn. SE162 (Violaceae) | Orita tāmavai | Flowers | Cold | Nutritive, Aphrodisiac | Oligospermia (1), Hypothyroidism (1) | Mal. (1), Hpo. (1) | 0.000 |
| 51.  | *Ipomoea aquatica* Forssk. SE191 (convolvulaceae) | Va aikkārāi | Leaves | Cold | Coolant, Lactagogue, Aphrodisiac, Antidiabetic | Mouth ulcers (1), Gastric ulcers (2), Oligospermia (2) | Gas. (3), Mal. (2) | 0.750 |
| 52.  | *Lagenaria siceraria* (Molina) Standl. SE104 (Cucurbitaceae) | Curaikkāy | Tender fruits | Cold | Coolant, Diuretic, Nutritive, Antibilious | Obesity (1), Coolant (1), To strengthen memory (1), Swelling of the limbs (1), Dysuria (2) | Uri. (3), Obe. (1), Coo. (1), Psy. (1) | 0.500 |
| 53.  | *Leucas aspera* (Willd.) Link SE112 (Lamiaceae) | Tumpai | Leaves | Hot | Laxative, Expectorant, Stimulant, Emmenagogue, To treat headache, throat ailments, polydipsia, cough, bronchitis, sinusitis, leucorrhea, fatigue, somatalgia | Rhinitis (1), Cough (1), Somatalgia (1) | Kap. (2), Ana. (1) | 0.500 |
| 54.  | *Limonia acidissima* Groff SE148 (Rutaceae) | Vi ā | Fruit bulbs | Cold | Aromatic, Coolant, To treat anorexia, bloating, polydipsia, cough and bronchitis | Diabetes (3), Polydipsia (1), Hypertension (1) | Dia. (4), Hpt. (1) | 0.750 |
| 55.  | *Macrotyloma uniflorum* (Lam.) Verdc. SE100 (Fabaceae) | Ko ā | Seeds | Hot | Astringent, Diuretic, Tonic | Obesity (1) | Obe. (1) | 0.000 |
| No. | Binomial name, Voucher number & Family | Vernacular name | Parts used | Humoral property | Reported pharmacological action in Siddha | Illnesses treated | Illnesses categories | IAR  |
|-----|--------------------------------------|----------------|------------|-----------------|------------------------------------------|-------------------|---------------------|------|
| 56. | Mangifera indica L. SE181 (Anacardiaceae) | Mā | Fruits | Hot | Laxative, Diuretic, Tonic, Aphrodisiac | Male infertility (2), Heart ailments (4), Anorexia (3), To increase vision (1) | Hea. (4), Mal. (2), Gas. (3), Eye. (1) | 0.666 |
| 57. | Marsilea quadrifolia L. SE195 (Marsileaceae) | Āraikkirai | Leaves | Cold | Coolant, Polyuria | Polyuria (2), Ulcers in urinary tract (2) | Dia. (2), Urt. (2) | 0.666 |
| 58. | Melochia corchorifolia L. SE189 (Malvaceae) | Punnaikkukkikai | Leaves | Cold | Diuretic, Laxative | Pain during menopause (1) | Gyn. (1) | 0.000 |
| 59. | Mentha arvensis L. SE171 (Lamiaceae) | Puti ă | Leaves | Hot | Stomachic, Diuretic, Stimulant, Carminative, Antispasmodic | Anemia (1), Anorexia (1) | Blo. (1), Ana. (1) | 0.000 |
| 60. | Momordica charantia L. SE149 (Cucurbitaceae) | Pāka kēy | Tender fruits | Hot | Tonic, Stomachic, Stimulant, Antibilious, Laxative, Alterative, Anthelmintic | Diabetes (1), Bloating (1), Intestinal worms (1) | Gas. (2), Dia. (1) | 0.500 |
| 61. | Moringa oleifera Lam. SE111 (Moringaceae) | Murukkai | Leaves | Cold | Antispasmodic, Stimulant, Expectorant, Diuretic, To treat anorexia, headache, fainting and eye ailments | Rhinitis (1), Cough (1), Somatalgia (2), Anemia (5), General weakness (1), To increase vision (1), Hypertension (2), Diabetes (1), Obesity (1), Anorexia (1), Menstrual migraine (2) | Blo. (5), Ana. (2), Hpt. (2), Gyn. (2), Kap. (2), Wea. (1), Eye. (1), Dia. (1), Obe. (1), Gas. (1) | 0.470 |
| 62. | Mukia maderaspatana (L.) M.Roem. SE160 (Cucurbitaceae) | Mucumucukkai | Leaves | Hot | Expectorant, To treat cough, bronchitis, wheezing, rhinitis | Asthma (2), Bronchitis (2), Cough (1) | Kap. (5) | 1.000 |
| 63. | Musa paradisiaca L. SE145 (Musaceae) | Vāai | Tender fruits, Flowers | Hot | Demulcent, Laxative, Nutritive, To treat hemorrhoids | Indigestion (2), Dysmenorrhea (1), Diabetes (1), Anemia (1), Obesity (1), Menstrual cramps (3), Gastric ulcers (3), Mouth ulcers (1), Hyperacidity (1), Menstrual clots (2), Bleeding through rectum (1) | Gas. (5), Hem. (3), Gyn. (3) | 0.800 |
| 64. | Nelumbo nucifera Gaertn. SE105 (Nelumbonaceae) | Tāmarai | Flowers | Cold | Coolant, Astringent, Expectorant, Sedative, To treat fever, polydipsia and liver ailments | Heart ailments (1) | Hea. (1) | 0.000 |
| 65. | Nigella sativa L. SE135 (Ranunculaceae) | Karuñcīrakam | Seeds | Hot | Carminative, Diuretic, Emmenagogue, Lactogogue, Anthelmintic, Stomachic, Antibiotic, Emmollient, To treat eczema, headache, cough, vomiting, nausea and jaundice | Somatalgia (1), Amenorrhea (1) | Ana. (1), Gyn. (1) | 0.000 |
| S.No | Binomial name, Voucher number & Family | Vernacular name | Parts used | Humoral property<sup>a</sup> | Reported pharmacological action in Siddha<sup>b</sup> | Illnesses treated | Illnesses categories | IAR |
|------|----------------------------------------|-----------------|------------|------------------------------|-------------------------------------------------|------------------|---------------------|-----|
| 67.  | *Oldenlandia umbellata* L. SE161 (Rubiaceae) | Impūrāl | Leaves | Cold | Expectorant, Styptic, Cholagogue, Good to treat internal bleeding | Productive cough (1), Bronchitis (1), Sinusitis (1) | Kap. (3) | | 1.000 |
| 68.  | *Oryza sativa* L. SE130 (Poaceae) | Arici | Seeds | Cold | Nutrient, Demulcent, Coolant | General weakness (2), Fatigue (1), Diabetes (1), Anemia (1) | Wea. (2), Fat. (1), Dia. (1), Blo. (1) | | 0.250 |
| 69.  | *Oxalis corniculata* L. SE203 (Oxalidaceae) | Pu lyārai | Leaves | Cold | Stomachic, Coolant, Astringent, To treat fainting, diarrhea, bleeding through anus and hemorrhoids | Hypertension (2), Insomnia (1) | Hpt. (2), Psy. (1) | | 0.500 |
| 70.  | *Ranicum sumatrense* Roth ex Roem. & Schult. SE121 (Poaceae) | Cāmai | Seeds | Cold | Demulcent, Tonic, To treat polydipsia, fever and musculoskeletal disorders | General weakness (2), Fatigue (1) | Wea. (2), Fat. (1) | | 0.500 |
| 71.  | *Paspalum scrobiculatum* L SE120 (Poaceae) | Varaku | Seeds | Cold | Chologogue | General weakness (2), Fatigue (1) | Wea. (2), Fat. (1) | | 0.500 |
| 72.  | *Pennisetum glaucum* (L.)R.Br. SE119 (Poaceae) | Kampu | Seeds | Cold | Tonic | General weakness (2), Fatigue (1), Anemia (1) | Wea. (2), Fat. (1), Blo. (1) | | 0.333 |
| 73.  | *Phoenix dactylifera* L. SE136 (Arecaceae) | Pērītcai | Fruits | Hot | Tonic, Nutritive, Demulcent, laxative, Diuretic, Febrifuge, Coolant, Expectorant, Aphrodisiac, Good to treat polydipsia, anorexia and diabetes | Male infertility (1), Hypotension (1), General weakness (1) | Mal. (1), Hpo. (1), Wea. (1) | | 0.000 |
| 74.  | *Phyllanthus emblica* L. SE152 (Phyllanthaceae) | Nellikkāy | Fruits | Cold | Astringent, Coolant, Diuretic, Laxative, To treat bronchitis, sinusitis, nausea, vomiting, giddiness and hypertension | Heart ailments (2), Anemia (2), Constipation (1), Wheezing (1), Burning sensation (1), Diabetes (1), Anorexia (2), Rheumatalgia (1), To increase vision (2), Hypothyroidism (1) | Gas. (3), Hea. (2), Blo. (2), Eye. (2), Kap. (1), Coo. (1), Dia. (1), Vad. (1), Hpo. (1) | | 0.384 |
| 75.  | *Piper longum* L. SE133 (Piperaceae) | Tippili | Seeds | Hot | Stimulant, Carminative, To treat cough, gastric ulcers, wheezing, anemia, fainting, anorexia, bloating, headache, sinusitis, throat ailments and oligosperma | Somatalgia (1) | Ana. (1) | | 0.000 |
| 76.  | *Piper nigrum* L. SE132 (Piperaceae) | Mi āku | Seeds | Hot | Acid, Carminative, Febrifuge, Rubefacient, Stimulant, Resolvent, Antidote | Somatalgia (1), Anemia (1), Anorexia (1) | Ana. (1), Blo. (1), Gas. (1) | | 0.000 |
| S.No | Binomial name, Voucher number & Family | Vernacular name | Parts used | Humoral property<sup>a</sup> | Reported pharmacological action in Siddha<sup>b</sup> | Illnesses treated | Illnesses categories | IAR |
|------|----------------------------------------|----------------|------------|-------------------------------|-----------------------------|------------------|---------------------|-----|
| 77.  | *Plectranthus amboinicus* (Lour.) Spreng. SE143 (Lamiaceae) | Ōmavalli | Leaves | Hot | Stimulant, Diaphoretic, Expectorant | Rhinitis (1), Bronchitis (1) | Kap. (2) | 1.000 |
| 78.  | *Portulaca quadrifida* L. SE173 (Portulacaceae) | Ci u pacalai | Leaves | Cold | Diuretic, Stomachic, Aphrodisiac, Antibilious | Dysuria (2), Gastric ulcers (2), Hypertension (1), Anemia (1) | Uri. (2), Gas. (2), Hpt. (1), Blo. (1) | 0.400 |
| 79.  | *Prunus dulcis* (Mill.) D. A. Webb SE128 (Rosaceae) | Vātumai | Seeds | Cold | Demulcent, Emollient, Nutrient | General weakness (2), Fatigue (1) | Wea. (2), Fat. (1) | 0.500 |
| 80.  | *Psidium guajava* L. SE179 (Myrtaceae) | Kayyō | Fruits | Hot | Tonic, Astringent | Hyperacidity (1), Constipation (2), Diabetes (1) | Gas. (3), Dia. (1) | 0.666 |
| 81.  | *Punica granatum* L. SE166 (Lythraceae) | Mātu ai | Fruits | Cold | Astringent, Coolant | Bromhirdosis (1), Hyperacidity (1), Constipation (1), Gastric ulcers (1), Anorexia (2), Wheezing (1), Rheumatalgia (1), To increase vision (1), Hypothyroidism (1) | Gas. (5), Der. (1), Kap. (1), Vad. (1), Eye. (1), Thy. (1) | 0.444 |
| 82.  | *Senna auriculata* (L.) Roxb. SE103 (Fabaceae) | Āvārai | Flowers | Cold | Astringent, Tonic, Good to treat Diabetes | Male infertility (1), Lumbago (1), Diabetes (2), Burning sensation (1) | Mal. (1), Vad. (1), Dia. (2), Coo. (1) | 0.000 |
| 83.  | *Sesamum indicum* L. SE16 Pedaliaceae | E | Seeds | Hot | Emmenagogue, Stimulant, Tonic, Diuretic, Lactagogue, Laxative | Male infertility (1), Diabetes (1), Amenorhea (1) | Mal. (1), Dia. (1), Gyn. (1) | 0.000 |
| 84.  | *Sesbania grandiflora* (L.) Poiret SE165 (Fabaceae) | Akatti | Leaves | Cold | Antidote, Coolant, Laxative, Vermifuge | Obesity (1), Gastric ulcers (3), Hemorrhoids (1), Burning sensation (1), Dysuria (1), Hypertension (1) | Gas. (3), Obe. (1), Hem. (1), Coo. (1), Ure. (1), Hpt. (1) | 0.285 |
| 85.  | *Setaria italica* (L.) P. Beauv. SE122 (Poaceae) | Ti ai | Seeds | Hot | Nutrient, Diuretic, Astringent, Appitizer | General weakness (2), Fatigue (1) | Wea. (2), Fat. (1) | 0.500 |
| 86.  | *Solanum americanum* Mill. SE158 (Solanaceae) | Manattakkā | Leaves | Cold | Alternative, Diuretic, Diaphoretic, Expectorant, To treat mouth ulcers and bronchitis | Menstrual migraine (1), Strength bones (1) and nerves (1), Bronchitis (1), Somatalgia (2), Heart ailments (1), Wheezing (1), Gastric ulcers (2), Mouth ulcers (2), Fever (1), Fatigue (1), Convulsions (1), Headache (1), Liver diseases (1), Jaundice (1), Mumps (1), Cough (1), Dermatological ailments (1), Hypertension (1), Constipation (1) | Gas. (5), Kap. (3), Det. (2), Neu. (2), Ana. (2), Gyn. (1), Bon. (1), Hea. (1), Fev. (1), Fat. (1), Hed. (1), Liv. (1), Jau. (1), Hpt. (1) | 0.409 |
| S.No | Binomial name, Voucher number & Family | Vernacular name, Parts used | Humoral property & Family | Reported pharmacological action in Siddha | Illnesses treated | Illnesses categories | IAR |
|------|--------------------------------------|----------------------------|--------------------------|------------------------------------------|-------------------|---------------------|-----|
| 87.  | Solanum lycopersicum SE180 (Solanaceae) | Takkā-ī Fruits | Cold | Tonic, Coolant, To treat anemia | Constipation (1), Heart ailments (1), Diabetes (1), Anorexia (1), Rheumatalgia (1), To increase vision (1) | Gas. (2), Hea. (1), Dia. (1), Vad. (1), Eye. (1) | 0.200 |
| 88.  | Solanum torvum Sw. SE146 (Solanaceae) | Curṇṭāikkāy Dried fruits | Hot | Expectorant, Germicide, Stomachic, To treat bloating, bronchitis, anorexia, intestinal worms and indigestion | Hypotension (1), Heart ailments (1), Bronchitis (1), Anemia (1), Wheezing (1), Diarrhea (1), Diabetes (1) | Kap. (2), Hpo. (1), Hea. (1), Blo. (1), Gas. (1), Dia. (1) | 0.166 |
| 89.  | Solanum trilobatum L. SE110 (Solanaceae) | Tūtuva ai Leaves | Hot | Stimulant, Expectorant, Tonic, Aphrodisiac, To treat bronchitis, cough and rhinitis | Rhinitis (1), Cough (1), Somatalgia (1), To increase memory (1), Male infertility (2), Oligosperma (1) | Mal. (3), Kap. (2), Ana. (1), Psy. (1) | 0.500 |
| 90.  | Sorghum bicolor (L.) Moench SE124 (Poaceae) | Ve aiccō am Seeds | Cold | Nutrient, Laxative | General weakness (2), Fatigue (1) | Wea. (2), Fat. (1) | 0.500 |
| 91.  | Spinacia oleracea L. SE175 (Amaranthaceae) | Pālakkiai Leaves | – | – | Hypertension (1) | Hpt. (1) | 0.000 |
| 92.  | Syzygium cumini (L.) Skeels SE151 (Myrtaceae) | Nōval Fruits | Cold | Stomachic, Diuretic, Tonic, Astringent, coolant, To treat polyuria, polydipsia and dysuria | Diabetes (2) | Dia. (2) | 1.000 |
| 93.  | Tamarindus indica L. SE198 (Fabaceae) | Pu i Fruits | Hot | Laxative, To treat vomiting and hypertension | Anorexia (1), Nausea (1) | Gas. (2) | 1.000 |
| 94.  | Trachyspermum ammi Sprague. SE115 (Apiaceae) | Ōmam Seeds | Hot | Stomachic, Antispasmodic, Carminative, Antiseptic, Stimulant, Tonic, Sialagogue, to treat Cough, Diarrhea, Wheezing and Toothache | Heart ailments (1), Somatalgia (1) | Hea. (1), Ana. (1) | 0.000 |
| 95.  | Tribulus terrestris L. SE187 (Aizoaceae) | Cāranai Leaves | Hot | Laxative, Diuretic, To treat jaundice, swelling, anemia and bronchitis | Heart ailments (1) | Hea. (1) | 0.000 |
| 96.  | Tribulus terrestris L. SE196 (Zygophyllaceae) | Či u neruṅkōl Leaves | Cold | Coolant, Diuretic, Demulcent, Tonic, Aphrodisiac, Astringent, To treat dysuria, fever, urolithiasis, enlargement of prostate, leucorrea and polydipsia | Dysuria (2), Oligosperma (2), Burning sensation (1) | Uri. (2), Mal. (2), Coo. (1) | 0.500 |
| 97.  | Trichosanthes cucumerina L. SE172 (Cucurbitaceae) | Puṭal Tender fruits | Cold | Coolant, Aphrodisiac | Oliguria (1) | Uri. (1) | 0.000 |
| S.No | Binomial name, Voucher number & Family | Vernacular name | Parts used | Humoral property<sup>a</sup> | Reported pharmacological action in Siddha<sup>a</sup> | Illnesses treated | Illnesses categories | IAR |
|------|-------------------------------------|----------------|------------|-----------------------------|-------------------------------------------------|----------------|-----------------|-----|
| 98.  | *Trigonella foenum-graecum* L. SE163 (Fabaceae) | Ventayam | Seeds | Cold | Coolant, Laxative, Diuretic, Demulcent, Astringent, Emollient, Aphrodisiac, Carminative, Tonic, To treat diarrhea, burning sensation, hypertension, fever, polydipsia and cough | Diabetes (1), Burning sensation (1), Anemia (2) | Blo. (2), Dia. (1), Coo. (1) | 0.333 |
| 99.  | *Triticum aestivum* L. SE164 (Poaceae) | Kōtumai | Seeds | Cold | Nutritive, Demulcent, Aphrodisiac, Antirheumatic | Diabetes (1) | Dia. (1) | 0.000 |
| 100. | *Vigna mungo* (L.) Hepper SE144 (Fabaceae) | U untu | Seeds | Cold | Demulcent, Coolant, Aphrodisiac, Lactogogue, Nervine tonic, Nutritive, Good to strengthen pelvic bones | General weakness (3), Burning sensation (1), Cervicalgia (1), Lumbago (1), Ovulation problems (1), As supplement after puberty (1), Diabetes (1), Anemia (1) | Wea. (3), Vad. (2), Gyn. (2), Coo. (1), Dia. (1), Blo. (1) | 0.444 |
| 101. | *Vitis vinifera* L. SE155 (Vitaceae) | Tirāṭcai | Fruits | Cold | Laxative, Coolant, Diuretic, Nutritive, to treat anemia, bleeding and heart ailments | Male infertility (1), Hypotension (1), Anemia (2), Anorexia (2), Constipation (1), Wheezing (1), Rheumatalgia (1) | Gas. (3), Blo. (2), Mal. (1), Hpo. (1), Kap. (1), Vad. (1) | 0.375 |
| 102. | *Zea mays* L. SE125 (Poaceae) | Makkāccō am | Seeds | Cold | Tonic, Aphrodisiac | General weakness (2), Fatigue (1) | Wea. (2), Fat. (1) | 0.500 |
| 103. | *Zingiber officinale* Roscoe. SE131 (Zingiberaceae) | Iñci | Rhizomes | Hot | Carminative, Stomachic, Sialogogue, Digestive, Stimulant, Rubefacient | Somatalgia (1), Bloating (1) | Ana. (1), Gas. (1) | 0.000 |
| 104. | *Ziziphus jujuba* Mill. SE186 (Rhamnaceae) | Ilantai | Fruits | Cold | Astringent, Emollient, Appetizer, Antiemetic | Anorexia (3), Nausea (1), Diabetes (1) | Gas. (4), Dia. (1) | 0.750 |

<sup>a</sup>- Data taken from *siddha materia medica* [41, 42]; Values given with in the parentheses indicate the number of UR for the respective illness/illness category.
| S.No | Binomial name                  | Vernacular name | Parts used | Humoral property   | Reported pharmacological action in *Siddha* | Illnesses treated                      | Illnesses categories | IAR |
|------|--------------------------------|-----------------|------------|--------------------|---------------------------------------------|----------------------------------------|----------------------|-----|
| 1    | Anguilla bengalensis           | Vilāṅku         | Meat       | Cold               | Aphrodisiac                                 | Fatigue (1), Joint pain (1)             | Fat. (1), Vad. (1)   | 0.000 |
| 2    | Bos taurus                     | Pacu            | Milk       | Cold               | To treat fever, internal ulcers, pain, urinary ailments, fatigue and emaciation | To increase memory (1), Burning sensation (2), Oliguria (1), Indigestion (1) | Psy. (1), Coo. (2), Uri. (1), Gas. (1) | 0.500 |
| 3    | Capra aegagrus hircus          | Ve āṭu          | Meat       | Cold               | Nutritive, Aphrodisiac, To treat fever and tuberculosis | Oligospermia (1), Impotence (1), Gastric ulcers (1), Bone fractures (2) | Mal. (2), Gas. (1), Bon. (2) | 0.500 |
| 4    | Canthax melampygus             | Pāi             | Meat       | –                  | –                                           | Anabolic (1), Cough (1), Chest pain (1), Wheezing (1), Coolant (1) | Anb. (1), Kap. (2), Hea. (1), Coo. (1) | 0.250 |
| 5    | Channa spp.                    | Virāl           | Meat       | –                  | –                                           | Anabolic (1), Oligospermia (1), Coolant (1) | Anb. (1), Mal. (1), Coo. (1) | 0.000 |
| 6    | Chanos chanos                  | Pāḷ keṇṭai      | Meat       | Cold               | –                                           | Lactogogue (1), Fatigue (1), Impotence (1) | Gyn. (1), Fat. (1), Mal. (1) | 0.000 |
| 7    | Bletheronema tetractylum       | Kāḷā            | Meat       | –                  | –                                           | Impotence (1), Heart diseases (1), Hypertension (1), Urolithiasis (2) | Uri. (2), Mal. (1), Hea. (1), Hpt. (1) | 0.250 |
| 8    | Ethynnus affinis               | Nīḷa tuṭuppū cāi ai | Meat | –                  | –                                           | Fever (1), Cough (2) | Kap. (2), Fev. (1) | 0.500 |
| 9    | Fenneropenaeus indicus         | Ve āi āi ālı    | Meat       | Hot                | Anabolic, To treat anemia                   | To improve vision (1), Anabolic (3), Lactogogue (1) | Anb. (3), Eye. (1), Gyn. (1) | 0.500 |
| 10   | Gallus gallus domesticus      | Kāḷi            | Eggs       | Cold               | Antirheumatic, Aphrodisiac, To treat ulcers and bronchitis | Anemia (2), Bronchitis for children (1) | Blo. (2), Kap. (1) | 0.500 |
| 11   | Gerres ayena                  | Uṭuvā           | Meat       | –                  | –                                           | Somatalgia (1), Bronchitis (1), Lactogogue (1) | Anb. (1), Kap. (1), Gyn. (1) | 0.000 |
| 12   | Gibelion catla                | Kaḷḷā           | Meat       | Cold               | –                                           | Fatigue (2), Somatalgia (1), Impotence (1), Lactogogue (2), To increase vision (1) | Fat. (2), Gyn. (2), Ana. (1), Mal. (1), Eye. (1) | 0.333 |
| 13   | Himantura uarnak              | Tiṟukkai        | Meat       | Hot                | Aphrodisiac                                 | Somatalgia (1), Wheezing (3) | Kap. (3), Ana. (1) | 0.666 |
| 14   | Katelysia opima               | Cippi           | Meat       | –                  | –                                           | Bronchitis (1), Impotence (2) | Mal. (2), Kap. (1) | 0.500 |
| 15   | Lactarius lactarius           | Cutumpu         | Meat       | –                  | –                                           | Chest pain (1) | Hea. (1) | 0.000 |
| 16   | Lates calcarifer              | Koṭuvā          | Meat       | –                  | –                                           | Rheumatogalia (3), Impotence (1) | Vad. (3), Mal. (1) | 0.666 |
| 17   | Lebeo rohita                  | Kanṟadī kendoi  | Meat       | –                  | –                                           | Somatalgia (1), Heart disease (1), Eye disease (1), Obesity (1) | Ana. (1), Hea. (1), Eye. (1), Obe. (1) | 0.000 |
Table 4 List of animal taxa cited by the non-institutionally trained *siddha* practitioners of Tiruvallur district of Tamil Nadu for preparing medicinal foods (Continued)

| S.No | Binomial name | Vernacular name | Parts used | Humoral property | Reported pharmacological action in *Siddha* | Illnesses treated | Illnesses categories | IAR  |
|------|---------------|-----------------|------------|------------------|---------------------------------------------|-------------------|----------------------|------|
| 18.  | *Monodactylus argenteus* (Linnaeus, 1758) | Puraṇṭi | Meat | – | – | Cough (1) | Kap. (1) | 0.000 |
| 19.  | *Mystus sp.* | Ke utti | Meat | Cold | Aphrodisiac | Bronchitis (1) | Kap. (1) | 0.000 |
| 20.  | *Nemipterus japonicas* (Bloch, 1791) | Caṅkarā | Meat | – | – | Chest pain (1) | Hea. (1) | 0.000 |
| 21.  | *Oreochromis mossambicus* (Peters, 1852) | Jilēppi | Meat | – | – | Bronchitis (1), Joint pain (1), Fatigue (1), Lactogogue (1), Chest pain (1) | Kap. (1), Vad. (1), Fat. (1), Gyn. (1), Hea. (1) | 0.000 |
| 22.  | *Pampus argenteus* (Euphrasen, 1788) | Vavāl | Meat | – | – | Cough (2), Lactogogue (1) | Kap. (2), Gyn. (1) | 0.500 |
| 23.  | *Rastrorhoma niger* (Bloch, 1795) | Karuppu vavāl | Meat | Hot | Aphrodisiac and lactogogue | Wheezing (3), To increase memory (1) | Kap. (3), Psy. (1) | 0.666 |
| 24.  | *Rastrophus hydrodromus* (Bloch, 1795) | Cē u nanṭu | Meat | Hot | Stimulant, Febrifuge, To treat bronchitis, rheumatism and indigestion | Fever (3) | Fev. (3) | 1.000 |
| 25.  | *Rutilus indicus* (Shaw, 1803) | Nakarai/ mussara | Meat | – | – | Coolant (1) | Coo. (1) | 0.000 |
| 26.  | *Portunus sanguinolentus* (Herbst, 1783) | Kaṭal naṇṭu | Meat | Hot | – | Bronchitis (3), Fever (2) | Kap. (3), Fev. (2) | 0.750 |
| 27.  | *Rachycentron canadus* (Linnaeus, 1766) | Ney mī | Meat | – | – | Good for pregnant women (1), Lactogogue (1) | Gyn. (2) | 1.000 |
| 28.  | *Rastrelliger kanagurta* (Cuvier, 1816) | Kā aṅkattai | Meat | – | – | Bronchitis (3) | Kap. (3) | 1.000 |
| 29.  | *Sardinella longiceps* Valenciennes, 1847 | Peichālai | Meat | – | – | Anabolic (4), Fatigue (1) | Anb. (4), Fat. (1) | 0.750 |
| 30.  | *Scoliodon laticaudus* Muller & Henle, 1838 | Pi oiccu ā | Meat | Hot | Appétizer, lactogogue, To treat rheumatism and bronchitis | Lactogogue (7) | Gyn. (7) | 1.000 |
| 31.  | *Scorberamurus guttatus* (Bloch & Schneider, 1801) | Vāhīram | Meat | – | – | Obesity (1), Fatigue (1), Chest pain (1), Rheumatalgia (1) | Obe. (1), Fat. (1), Hea. (1), Vad. (1) | 0.000 |
| 32.  | *Sphyraena jello* Cuvier in Cuvier & Valenciennes, 1829 | Ū i | Meat | – | – | Lactogogue (1), Anabolic (2), Coolant (1) | Anb. (2), Gyn. (1), Coo. (1) | 0.333 |
| 33.  | *Stolephorus indicus* (van Hasselt, 1823) | Nettill | Meat | – | – | Cough (1), Wheezing (2), Lactogogue (2) | Kap. (3), Gyn. (2) | 0.750 |
| 34.  | *Stolephorus spp.* | – | Meat | – | – | Oligospermia (2) | Mal. (2) | 1.000 |
| 35.  | *Thryssa malabarica* (Bloch, 1795) | Poruvā | Meat | – | – | Arthritis (1) | Vad. (1) | 0.000 |
Table 4: List of animal taxa cited by the non-institutionally trained siddha practitioners of Tiruvaallur district of Tamil Nadu for preparing medicinal foods (Continued)

| S.No | Binomial name | Vernacular name | Parts used | Humoral property | Reported pharmacological action in Siddha<sup>a</sup> | Illnesses treated | Illnesses categories | IAR |
|------|---------------|-----------------|------------|------------------|---------------------------------------------------|-------------------|----------------------|-----|
| 36.  | Trichiurus lepturus Linnaeus, 1758 | Olai vā al | Meat | Hot | Appetizer, to treat bronchitis and rheumatism | Giddiness (1), Bronchitis (2), Joint pain (1) | Kap. (2), Hyp. (1), Vad. (1) | 0.333 |
|      | *Eupleurogrammus muticus* (Gray, 1831) | | | | | |
| 37.  | Upeneus sulphureus Cuvier, 1829 | Navarai | Meat | – | – | Joint pain (2) | Vad. (2) | 1.000 |
| 38.  | *Uroteuthis duvauceli* (d’Orbigny, 1835) | Ūci ka avā | Meat | – | – | Anemia (2), Rheumatalgia (1), Bronchitis (1) | Blo. (2), Vad. (1), Kap. (1) | 0.333 |

<sup>a</sup> Data taken from siddha materia medica [43, 44]; Values given with in the parentheses indicate the number of UR for the respective illness/illness category.
of *Ipomoea aquatica* (water spinach) and onion had high IAR score; the use of flowers of *Solanum trilobatum* had high UR. The use of citron had high UR and IAR for the treatment of hypertension. Other important plants under this group were *Solanum americanum* (dermatological ailments), *Cardiospermum halicacabum* (analgesics), *Borassus flabellifer* (coolants), *Citrus limon* (vadha ailments), *Centella asiatica* (psychological ailments), and *Phyllanthus emblica* (eye ailments) (Table 6).

Illness categories treated with animal-based medicinal foods having high consensus

The hoofs of *Capra aegagrus hircus* (goat) had been given to treat bone fractures. The use of milk and testes of goat, and the meat of *Katelysia opima* to treat male reproductive ailments had high UR; and the use of *Stolephorus* meat had high IAR score. The use of *Gallus gallus domesticus* eggs (chicken) and *Uroteuthis duvauceli* (Indian squid) had high UR under the category of blood ailments and were used to treat anemia. *Sardinella longiceps* (Indian oil sardine) and *Fenneropenaeus indicus* (Indian prawn) had high UR under the anabolics (Table 6).

Illness categories treated with animal-based medicinal foods having average consensus

In the case of gynecological ailments, *Scoliodon laticaudus* (spade nose shark) had high UR and IAR value; it was reported to increase lactation. In the case of urinary ailments, *Eleutheronema tetradactylum* (fourfinger threadfin) had high UR and was reported to treat urolithiasis. In the case of *kapha* ailments, *Himantura uarnak* (reticulate whipray) had high number of UR; *Rastrelliger kanagurta* (Indian mackerel) and *Stolephorus indicus* (Indian anchovy) had high IAR values. In the case of fever, *Parathelphusa hydrodromus* and *Portunus sanguinolentus* (blood spotted swimming crab) had high UR and IAR scores. Other important animals under this category were *Gibelion catla* (catla) to treat fatigue, *Lates calcarifer* (barramundi) and *Upeneus sulphureus* to treat vadha ailments, and the buttermilk of *Bos taurus* (cow) as coolant (Table 6).

Relationship between the humoral properties and illnesses

In the case of plant-based medicinal foods, the RFC for plants with cold humor was comparatively high (64.08%) compared to the plants with cold humor. In animal-based medications, no such variation was found. The illness categories such as analgesics, hemorrhoids, and *kapha* ailments had comparatively high RFC for plants with hot humor. In the case of animal-based foods, the categories such as fever, gynecological ailments, and *kapha* ailments have high RFC for plants with hot humor (Table 7).
| Illness categories       | Abbreviations used | N_{UR} | % UR | N_{T} | % T | N_{C} | N_{VC} | F_{IC} |
|-------------------------|--------------------|--------|------|--------|------|--------|--------|--------|
| Analgesics              | Ana.               | 18     | 3.94 | 14     | 13.46| 14     | 3      | 0.235  |
| Anabolic                | Anb.               | –      | –    | –      | –    | –      | –      | –      |
| Blood ailments          | Blo.               | 29     | 6.35 | 18     | 17.30| 18     | 8      | 0.379  |
| Bone fracture           | Bon.               | 2      | 0.43 | 2      | 1.92 | 2      | 0      | 0.000  |
| Coolants                | Coo.               | 18     | 3.94 | 14     | 13.46| 14     | 3      | 0.235  |
| Dermatological ailments | Der.               | 5      | 1.09 | 4      | 3.84 | 4      | 1      | 0.250  |
| Diabetes                | Dia.               | 35     | 7.67 | 24     | 23.07| 24     | 6      | 0.323  |
| Eye ailments            | Eye.               | 9      | 1.97 | 8      | 7.69 | 8      | 1      | 0.125  |
| Fatigue                 | Fat.               | 14     | 3.07 | 14     | 13.46| 14     | 0      | 0.000  |
| Fever                   | Fev.               | 2      | 0.43 | 2      | 1.92 | 2      | 0      | 0.000  |
| Gastrointestinal ailments| Gas.              | 90     | 19.73| 36     | 34.61| 36     | 26     | 0.606  |
| Gynecological ailments  | Gyn.               | 20     | 4.38 | 13     | 12.50| 13     | 4      | 0.368  |
| Headache                | Hed.               | 1      | 0.21 | 1      | 0.96 | 1      | 0      | 0.000  |
| Heart ailments          | Hea.               | 21     | 4.60 | 15     | 14.42| 15     | 4      | 0.300  |
| Hemorrhoids             | Hem.               | 20     | 4.38 | 8      | 7.69 | 8      | 6      | 0.613  |
| Hypertension            | Hpt.               | 13     | 2.85 | 10     | 9.61 | 10     | 3      | 0.250  |
| Hypotension             | Hpo.               | 8      | 1.74 | 8      | 7.69 | 8      | 0      | 0.000  |
| Hypothyroidism          | Thy.               | 3      | 0.65 | 3      | 2.88 | 3      | 0      | 0.000  |
| Jaundice                | Jau.               | 2      | 0.43 | 2      | 1.92 | 2      | 0      | 0.000  |
| Kapha ailments          | Kap.               | 32     | 7.01 | 17     | 16.34| 17     | 10     | 0.483  |
| Liver ailments          | Liv.               | 4      | 0.87 | 3      | 2.88 | 3      | 1      | 0.333  |
| Male reproductive ailments| Mal.              | 28     | 6.14 | 21     | 20.19| 21     | 6      | 0.259  |
| Neural ailments         | Neu.               | 2      | 0.43 | 1      | 0.96 | 1      | 1      | 1.000  |
| Obesity                 | Obe.               | 8      | 1.74 | 8      | 7.69 | 8      | 0      | 0.000  |
| Psychological ailments  | Psy.               | 8      | 1.74 | 7      | 6.73 | 7      | 1      | 0.142  |
| Urinary ailments        | Uni.               | 18     | 3.94 | 11     | 10.57| 11     | 5      | 0.411  |
| Vadha ailments          | Vad.               | 11     | 2.41 | 9      | 8.65 | 9      | 2      | 0.200  |
| Weakness                | Wea.               | 35     | 7.67 | 19     | 6.50 | 19     | 15     | 0.470  |
| Analgesics              | Ana.               | 4      | 3.07 | 4      | 10.52| 4      | 1      | 0.000  |
| Anabolic                | Anb.               | 11     | 8.46 | 5      | 13.15| 5      | 2      | 0.600  |
| Blood ailments          | Blo.               | 4      | 3.07 | 2      | 5.26 | 2      | 2      | 0.666  |
| Bone fracture           | Bon.               | 2      | 1.53 | 1      | 2.61 | 1      | 1      | 1.000  |
| Coolants                | Coo.               | 6      | 4.61 | 5      | 13.15| 5      | 1      | 0.200  |
| Dermatological ailments | Der.               | –      | –    | –      | –    | –      | –      | –      |
| Diabetes                | Dia.               | –      | –    | –      | –    | –      | –      | –      |
| Eye ailments            | Eye.               | 3      | 2.30 | 3      | 7.89 | 3      | 0      | 0.000  |
| Fatigue                 | Fat.               | 7      | 5.38 | 6      | 15.78| 6      | 1      | 0.375  |
| Fever                   | Fev.               | 6      | 4.61 | 3      | 7.89 | 3      | 2      | 0.166  |
| Gastrointestinal ailments| Gas.              | 2      | 0.76 | 2      | 2.61 | 2      | 0      | 0.000  |
| Gynecological ailments  | Gyn.               | 19     | 4.61 | 10     | 26.31| 10     | 4      | 0.500  |
| Headache                | Hed.               | –      | –    | –      | –    | –      | –      | –      |
| Heart ailments          | Hea.               | 7      | 5.38 | 7      | 18.42| 7      | 0      | 0.000  |
| Hemorrhoids             | Hem.               | –      | –    | –      | –    | –      | –      | –      |
CFSI scores of the medicinal foods

List of plant and animal taxa having top ten CFSI scores are given in Table 8, and the CFSI scores for all taxa are given in Additional file 1: Table S2. It showed that the average CFSI score of the plant taxa was higher than that of the animal taxa.

Discussion

In Indian systems of traditional medicine, diet recommendation is an integral and important part of the therapy; it is considered as an ally for strengthening the drug efficacy [46]. However, this knowledge is poorly documented and under-utilized. Our previous studies in other districts of Tamil Nadu also indicated that non-institutional training of siddha system is a male dominant domain [37], and cultural reasons play a vital role on low women's participation. Such unevenness was also recorded in some ethnobiological studies in other geographical parts [47]. Traditional medicine was often perceived as the healthcare option only for the poor and marginalized communities; a recent work in Nepal indicated that these practices prevailed both in rural and semi-urban areas, and it showed positive correlation with household income and traditional medicine use [48]. The data of this study also indirectly substantiated the previous work by showing relatively high percentage of traditional healers in urban and semi-urban areas.

Sampling sufficiency and the representativeness of the samples collected are considered as major concerns of modern ethnobiology research [49], and various methods are employed to ascertain them. Application of species richness curve was one of the methods, and in this study, it was done by plotting Shannon-Wiener’s index in ordinate axis (y) and cumulative number of UR in abscissa axis (x). Reaching a clear asymptote of the curve was considered as an indicator for the sufficiency of sampling. Comparatively low Shannon-Wiener score for the animal-based foods indicated the lack of diversity in the animal foods than plant foods. The traditional medical literatures of ayurveda and siddha described about the health benefits of animal-based foods; however, the cultural and spiritual beliefs along with better understanding of the nutritional properties of plants caused a preference of vegetarianism in India [50]. Our previous study on ethnodietetics among non-institutionally trained siddha practitioners of Virudhunagar district had also yielded high number of UR for plant-based foods [12]. The same trend was reflected in this survey, and plant taxa got high UR and average IAR values. The CFSI scores for the plant taxa were comparatively higher than that of animal taxa. Our previous surveys in inland of Tamil Nadu showed low UR for fish taxa [12, 51]. In this survey, comparatively better availability of fish taxa caused more UR towards them.

Gastrointestinal ailments are one of the illnesses which got high number of UR in many ethnopharmacological explorations [52]. Food is directly related with various gastrointestinal illnesses, and the use of medicinal foods among subjects with functional gastrointestinal disorders was also high [53, 54]. The use of citron got a high number of UR in this study; it has also been used to treat gastrointestinal ailments in ayurveda and Chinese system of traditional medicine [55]. It has also been used for the treatment of the same in countries such as Nepal [56] and

Table 5 FIC values for illness categories treated with plant-based medicinal foods by the non-institutionally trained siddha practitioners in Tiruvallur district (Continued)

| Illness categories | Abbreviations used | N<sub>UR</sub> | % UR | N<sub>t</sub> | % T | N<sub>c</sub> | N<sub>vc</sub> | F<sub>IC</sub> |
|--------------------|-------------------|----------------|------|-------------|-----|-------------|-------------|----------|
| Hypertension       | Hpt.              | 1              | 1.538| 1           | 5.263| 1           | 1           | 0        |
| Hypotension        | Hpo.              | –              | –    | –           | –    | –           | –           | –        |
| Hypothyroidism     | Thy.              | 1              | 1.538| 1           | 5.263| 1           | 1           | 0        |
| Jaundice           | Jau.              | –              | –    | –           | –    | –           | –           | –        |
| Kapha ailments     | Kap.              | 30             | 23.076| 16         | 44.736| 16         | 9           | 0.482    |
| Liver ailments     | Liv.              | –              | –    | –           | –    | –           | –           | –        |
| Male reproductive ailments | Mal.    | 11             | 6.923| 8           | 21.052| 8           | 3           | 0.714    |
| Neural ailments    | Neu.              | –              | –    | –           | –    | –           | –           | –        |
| Obesity            | Obe.              | 2              | 1.538| 2           | 2.613| 2           | 0           | 0.000    |
| Psychological ailments | Psy.      | 2              | 1.538| 2           | 2.613| 2           | 0           | 0.000    |
| Urinary ailments   | Uri.              | 3              | 2.564| 2           | 2.613| 2           | 1           | 0.500    |
| Vadha ailments     | Vad.              | 11             | 8.461| 8           | 23.684| 9           | 2           | 0.222    |
| Weakness           | Wea.              | –              | –    | –           | –    | –           | –           | –        |

* N<sub>UR</sub> number of use reports, % UR % of use reports, N<sub>t</sub> number of taxa, % T % of taxa, N<sub>c</sub> number of claims, N<sub>vc</sub> number of valid claims, – no UR and F<sub>IC</sub> value was not calculated.
| Illness categories       | Plants                                                                 | Animals                                                                 |
|--------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------|
| Analgesics               | Cardiospermum halicacabum (0.750), Moringa oleifera (0.470), Solanum americanum (0.409) | –                                                                      |
| Anabolic                 | –                                                                      | Sardinella longiceps (1.000), Fenneropenaeus indicus (0.500), Sphyraena jello (0.333) |
| Blood ailments           | Moringa oleifera (0.470), Beta vulgaris (0.333), Eclipta prostrata (0.400), Eleusine coracana (0.333), Ficus racemosa (0.428), Phyllanthus emblica (0.384), Trigonella foenum-graecum (0.333), Vitis vinifera (0.375) | Gallus gallus domesticus (0.500), Uroteuthis duvauceli (0.333) |
| Bone fracture            | –                                                                      | Capra aegagrus hircus (0.333)                                          |
| Coolants                 | Borassus flabellifer (0.666), Coccinia grandis (0.692), Cuminum cyminum (0.428) | Bos taurus (0.500)                                                     |
| Dermatological ailments  | Solanum americanum (0.409)                                            | –                                                                      |
| Diabetes                 | Coccinia grandis (0.692), Limonia acidissima (0.750), Abelmoschus esculentus (0.333), Brassica oleracea var. gongyloides (1.000), Marsilea quadridiata (0.666), Syzygium cumini (1.000) | –                                                                      |
| Eye ailments             | Phyllanthus emblica (0.384)                                           | –                                                                      |
| Fatigue                  | –                                                                      | Gibelion catla (0.333)                                                 |
| Fever                    | –                                                                      | Parathelphusa hydromedus (1.000), Portunus sanguinolentus (0.750)       |
| Gastrointestinal ailments| Citrus medica (0.666), Coccinia grandis (0.692), Musa paradisiaca (0.800), Punica granatum (0.444), Solanum americanum (0.409), Citrus limon (0.400), Murraya koenigii (0.428), Ziziphus jujuba (0.750), Cuminum cyminum (0.428), Ipomoea aquatic (0.750), Mangifera indica (0.666), Phyllanthus emblica (0.384), Psidium guajava (0.666), Sesbania grandiflora (0.285), Vitis vinifera (0.375), Allium sativum (0.250), Cistus lanatus (0.500), Cocos nucifera (0.333), Cucumis sativus (1.000), Daucus carota (0.333), Digera muricata (1.000), Ficus racemosa (0.428), Momordica charantia (0.500), Portulaca quadrifida (0.400), Solarium lycopersicum (0.200), Tamarindus indica (1.000) | –                                                                      |
| Gynecological ailments   | Aloe vera (0.428), Musa paradisiaca (0.800), Moringa oleifera (0.470), Vigna mungo (0.444) | Scolioodon iticatia (1.000), Gibelion catla (0.333), Rastrelliger canadus (1.000), Stolephorus indicus (0.750) |
| Headache                 | –                                                                      | –                                                                      |
| Heart ailments           | Mangifera indica (0.666), Citrus medica (0.666), Hibiscus rosa-sinensis (0.500), Phyllanthus emblica (0.384) | –                                                                      |
| Hemorrhoids              | Allium cepa (0.666), Abutilon indicum (1.000), Amorphophallus paeonifolius (0.666), Cissus quadrangularis (0.400), Musa paradisiaca (0.800), Acalypha indica (0.333) | –                                                                      |
| Hypertension             | Citrus medica (0.666), Moringa oleifera (0.470), Oxalis corniculata (0.500) | –                                                                      |
| Hypotension              | –                                                                      | –                                                                      |
| Hypothyroidism           | –                                                                      | –                                                                      |
| Jaundice                 | –                                                                      | –                                                                      |
| Kapha ailments           | Mukia maderaspatana (1.000), Solanum americanum (0.409), Cardiospermum halicacabum (0.750), Cleome gynandra (0.250), Leucas aspera (0.250), Moringa oleifera (0.470), Plectranthus amboinicus (1.000), Solanum torvum (0.166), Solarium lycopersicum (0.900) | Himantura uarnak (0.500), Parastromateus niger (0.666), Rastrelliger kanagurta (1.000), Stolephorus indicus (0.750), Euthynhymus affinis (0.500), Pampus argenteus (0.500), Trichiurus lepturus Eupleurogrammus muticus (0.333) |
| Liver ailments           | Eclipta prostrata (0.400)                                            | –                                                                      |
| Male reproductive ailments| –                                                                      | Capra aegagrus hircus (0.500), Katelysia opima (0.500), Stolephorus spp. (1.000) |
Pakistan [57]. A small clinical study with 37 subjects having recurrent aphthous stomatitis indicated that the application of citrus essential oil alleviated the pain in oral ulcers [58]. Some preliminary scientific experiments on Citrus fruits revealed the effectiveness on Helicobacter pylori [59]. From Citrus fruits, the compounds such as nobiletin [60], hesperidin, neohesperidin [61], β-myrcene [62], limonene, β-pinene [63], and 7,8-dimethoxycoumarin [64] were reported to have gastroprotective effects. Despite its traditional usage in many geographical areas and preclinical evidences, this claim lacks robust clinical data. Preliminary preclinical evidences supported the use of ivy gourd [65] and plantain for the treatment of gastric ulcer [66], but no clinical studies were available. The use of pomegranate was reported for the treatment of gastrointestinal ailments in Mexico [67] and Algeria [68]. Solanum americanum is one of the important plants of Tamil Nadu used to treat gastrointestinal ailments [69], and it is also used to treat gastrointestinal ailments in some other groups [70, 71]. Our previous ethnobotanical explorations had also documented the use of onion, Abutilon indicum, and elephant foot yam to treat hemorrhoids [37, 40, 72]; no scientific validation was reported.

Our previous surveys documented the use of Mukia maderaspatana in treating various pulmonary ailments [37, 40, 51, 72]. Boerhavia diffusa had been used to treat renal illnesses also in other geographic regions, and preclinical investigations showed its nephroprotective and antilithiasis effects [73, 74]. Moringa oleifera leaves are used as a supplement to treat anemia in other regions also [75], and according to a preclinical study, the dietary iron in M. oleifera is reported as superior to ferric citrate [76]. In ayurveda also, Aloe vera has been used to treat various gynecological ailments [77].

Eclipta prostrata is one of the important plants used in Indian as well as Chinese systems of traditional medicine for hepatoprotection [55]. Kohlrabi is an exotic taxon to India; it was not mentioned in the siddha materia medica, but it was prescribed by the informants of this study. Studies on such claims may yield some clues on knowledge transmission about the uses of exotic flora. Antidiabetic effect of Brassica oleracea was reported [78]; the antidiabetic effect of red kohlrabi was found to be superior to the green variety by a preclinical experiment [79]. A randomized, double blind trial with 63 type 2 diabetic subjects showed that the administration of broccoli (a variety of Brassica oleracea) powder at 10 g/day significantly lowered the insulin resistance [80]. Though Syzygium cumini was reported for diabetes by many previous studies, its antidiabetic efficacy was inconclusive [81]. The use of ivy gourd for the treatment of diabetes was also documented in Sri Lanka [82], Bangladesh [83], and Pakistan [84]. A small, double blinded phase I trial with 61 healthy volunteers indicated that consumption of 20 g of ivy gourd leaves significantly lowered the fasting and post-prandial glucose levels [85]. Pretreatment with mangiferin to isoproterenol induced myocardial infarcted rats prevented the alterations in mitochondrial energy metabolism and structural integrity of the heart tissues [86]. Cardioprotective effect of citron was recently

Table 6 List of important plant and animal medicinal food taxa cited by the non-institutionally trained Siddha practitioners of Tiruvallur district, Tamil Nadu, to treat various ailments (Continued)

| Illness categories | Plants | Animals |
|-------------------|--------|---------|
| Neural ailments   | Solanum americanum (0.409) | – |
| Obesity           | –      | –       |
| Psychological ailments | Centella asiatica (0.500) | – |
| Urinary ailments  | Boerhavia diffusa (1.000), Lagenaria siceraria (0.500), Vigna mungo (0.444), Tribulus terrestris (0.500) | Eleutheroneuma tetracyclatum (0.250) |
| Vadha ailments    | Citrus limon (0.400), Vigna mungo (0.444) | Lates calcarifer (1.000), Upeneus sulphureus (1.0) |
| Weakness          | Vigna mungo (0.444), Amaranthus viridis (0.333), Anocardium occidentale (0.500), Arachis hypogaea (0.500), Cicer arietinum (0.333), Echinochloa frumentacea (0.500), Eleusine coracana (0.333), Osyza sativa (0.250), Panicum sumatrense (0.500), Paspalum scrobiculatum (0.500), Pennisetum glaucum (0.333), Prunus dulcis (0.500), Setaria italica (0.500), Sorghum bicolor (0.500), Zea mays (0.500) | – |

The values mentioned within the parentheses indicate the IAR values. Taxa are arranged in descending order of UR.
reviewed [87]; no clinical reports were available to substantiate the cardioprotective effect of mango and citron supplementation. The use of Citrus fruits for the management of hypertension by Polish migrants in Argentina was already reported [88], and small double-blind, cross-over study with 12 stage I hypertensive patients indicated its usefulness [25]. Two small clinical studies showed the anxiolytic potential of Centella asiatica [89, 90].

The principle of using meat of an organ to treat the illnesses of the similar organ (similia similibus curantur) was reported in previous ethnopharmacological surveys [51, 91]. Previous studies in various geographical locations documented the use of testes and bones of goat to treat male reproductive [92] and bone [93] ailments, respectively. Geographic accessibility was one of the important factors that determined the popularity of zootherapy [94]; this study also represented that the accessibility of marine taxa caused more UR for them among the animal-based foods. Deb and Haque [95] documented the importance of fish taxa in the culture of people in coastal region; however, the ethnopharmacology of fish taxa in India still has to be documented thoroughly. Various medicinal properties of molluscs were recently reviewed [96]; this study documented the use of two molluscs viz., Katelysia opima and Indian squid for the treatment of impotence and anemia, respectively. Indian oil sardine has high ω-3 fatty acid content, high ω-3/ω-6 ratio, eicosapentaenoic acid, and docosahexaenoic acid [97], which may help to gain healthy weight. The use of spade nose shark to improve lactation had got high UR and IAR under gynecological ailments;

| Illness categories          | Plant food taxa | Animal food taxa |
|----------------------------|-----------------|-----------------|
|                            | Hot     | Cold | Unspecified | Hot     | Cold | Unspecified |
| Analgesics                 | 72.22   | 27.78 | –           | 25      | 25   | 50          |
| Anabolic                   | –       | –    | –           | 9.09    | –    | 90.90       |
| Blood ailments             | 24.13   | 68.97 | 6.90        | –       | 50   | 50          |
| Bone fracture              | 50      | 50   | –           | –       | 100  | –           |
| Coolants                   | 11.11   | 88.89 | –           | –       | 33.33| 66.66       |
| Dermatological ailments    | 20      | 80   | –           | –       | –    | –           |
| Diabetes                   | 22.86   | 71.42 | 5.72        | –       | –    | –           |
| Eye ailments               | 33.33   | 66.67 | –           | 33.33   | 33.33| 33.33       |
| Fatigue                    | 14.28   | 78.58 | 7.14        | –       | 57.14| 42.85       |
| Fever                      | 50      | 50   | –           | 83.33   | –    | 16.66       |
| Gastrointestinal ailments  | 35.56   | 62.22 | 2.22        | –       | 100  | –           |
| Gynecological ailments     | 40      | 60   | –           | 42.10   | 15.78| 42.10       |
| Headache                   | 0       | 100  | –           | –       | –    | –           |
| Heart ailments             | 52.35   | 42.65 | 5.00        | 0       | 0    | 100         |
| Hemorrhoids                | 60      | 40   | –           | –       | –    | –           |
| Hypertension               | 0       | 92.30| 7.70        | 0       | 0    | 100         |
| Hypotension                | 25      | 50   | 25          | –       | –    | –           |
| Hypothyroidism             | 33.33   | 66.67 | –           | 100     | 0    | 0           |
| Jaundice                   | 0       | 100  | –           | –       | –    | –           |
| Kapha ailments             | 59.37   | 40.63| –           | 36.66   | 6.66 | 56.66       |
| Liver ailments             | 50      | 50   | –           | –       | –    | –           |
| Male reproductive ailments | 39.28   | 50   | 10.72       | 0       | 36.36| 63.63       |
| Neural ailments            | 50      | 50   | –           | –       | –    | –           |
| Obesity                    | 50      | 50   | –           | 0       | 0    | 100         |
| Psychological ailments     | 25      | 75   | –           | 50      | 50   | 0           |
| Urinary ailments           | 16.66   | 83.33 | –           | 0       | 33.33| 66.66       |
| Vadha ailments             | 36.37   | 63.63| –           | 9.09    | 9.09 | 81.81       |
| Weakness                   | 22.85   | 71.42| 5.73        | –       | –    | –           |

– No UR and frequency was not calculated

Table 7 Frequency of URs for illness categories treated with plant and animal medicinal food taxa on the basis of humors
however, no scientific report is available to validate this claim. The study by Deb and Haque [95] documented the use of catla as lactogogue, *Anguilla bengalensis bengalensis* for the treatment of arthritis, and *Channa spp.*, for oligospermia. They also documented reticulate whipray (wheezing and bronchitis), *Katelysia opima* (impotence), Indian squid (anemia), and Indian oil sardine (anabolic) for the treatment of various illnesses. Generally, ethnopharmacological validations on ethnozoological claims are very meager and Indian marine resources are still under-utilized. Scientific studies on these claims may yield some novel and affordable functional foods.

– Documentation of ethnopharmacological knowledge of marine resources is comparatively low in India. Indian coastal line spreads over 7516 km, and robust studies on the documentation of the traditional knowledge on marine resources will yield a good database for various stakeholders and policy makers.

– Among zootherapy, the use of organs to treat illnesses of similar organs was documented in many instances. Future-specific studies will reveal the cultural and pharmacological importance of this claim.

### Table 8

| Name of the taxa                        | CFSI |
|----------------------------------------|------|
| **Plants**                             |      |
| *Solanum americanum*                   | 110.28|
| *Murraya koenigii*                     | 97.20 |
| *Moringa oleifera*                     | 95.64 |
| *Cuminum cyminum*                      | 63.84 |
| *Musa paradisiaca*                     | 55.68 |
| *Coccinia grandis*                     | 46.67 |
| *Phyllanthus emblica*                  | 45.36 |
| *Solanum lycopersicum*                 | 40.50 |
| *Vitis vinifera*                       | 40.24 |
| *Punica granatum*                      | 39.96 |
| **Animals**                            |      |
| *Portunus sanguinolentus*              | 33.75 |
| *Sardinella longiceps*                 | 29.25 |
| *Fenneropenaeus indicus*               | 27.00 |
| *Stolephorus indicus*                  | 22.50 |
| *Bos taurus*                           | 19.50 |
| *Rastrelliger kanagurta*               | 18.22 |
| *Sphyraena jello*                      | 16.20 |
| *Scoliodon laticaudus*                 | 15.75 |
| *Himantura uarnak*                     | 13.50 |
| *Parastromateus niger*                 | 13.50 |

**Abutilon indicum**, onions and elephant foot yam (hemorrhoids), *Boerhavia diffusa* (urinary ailments), *Moringa oleifera* (anemia), *Aloe vera* (gynecological ailments), *Eclipta prostrata* (liver ailments), ivy gourd (diabetes), citron (hypertension), and *Centella asiatica* (psychological ailments). More studies on these claims will help identify novel functional foods to add to the field of medical nutrition therapy, with traditional brand identity.

**Conclusions**

– This preliminary report quantitatively documented the food-medicine continuum among the non-institutionally trained *siddha* practitioners of Tiruvallur district. Collectivistic cultures, influence of traditional norms, and medicinal beliefs caused Indian dietary habits to be very unique; this provides ample scope for further research to anthropologists and ethnobiologists. Deeper studies on different dietary cultures of India may help derive better interpretations on food-medicine continuum.

– This study identified some important plant-based medicinal claims such as citron, pomegranate and *Solanum americanum* (gastrointestinal ailments),
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Availability of data and materials
All the data generated in this study are included with this article. Field notebooks and herbarium specimens were available at the museum of Entomology Research Institute, Loyola College, Chennai, Tamil Nadu, 600034, India.

Authors’ contributions
SI, PP, and NAA conceived the idea and designed the study. SE, SD, SM, PP, and MGP were involved in the field study and species confirmation. SE, SI, PP, and NAA processed and analyzed the data and prepared the manuscript. All the authors read and approved the manuscript.

Ethics approval and consent to participate
This study is approved by the Institutional Ethics Committee for Ethnobiological Research (sanction number ER/IEEC/2014/01). Written informant consent was obtained from all informants who were willing to participate.

Consent for publication
Consent for publication was obtained from the informants.

Competing interests
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