



RESEARCH ARTICLE

Ethnobotanic survey of the galactagogue plants used by Brong and Koulango, two indigenous peoples in Gontougo region/Côte d'Ivoire

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Abstract

This study aims to inventory plants and traditional medicinal recipes used by the population of Tanda (Gontougo region, Côte d'Ivoire) to boost milk production in women.

Using a questionnaire, the methods consisted in carrying out a survey near the traditional medicine actors of 15 localities. Among 47 actors of traditional medicine aged from 34 to 80 years investigated, 70.21 % were women. These women had more knowledge on the galactagogue plants than the men (29.79 % of the actors). They were represented by matrons, specialists in lactation, healers and saleswomen of medicinal plants. Among about fifteen listed galactagogue plants, *Euphorbia hirta* (Euphorbiaceae) was the most used plant. Leaves represented the majority of the medicinal preparations (73.33 %). These preparations were in 66.67 % of the cases associated with various other biological or mineral ingredients (pepper, meat, vegetables, ash, kaolin. . .). The direct application of crushings on mammary glands (cutaneous way) by friction constituted the principal route of administration (66.67 % of the medical receipts).

Traditional medicine actors of the town of Tanda are actively interested in the search of solutions to the lacteal secretion issues which occur in the breast-feeding mothers. They have about fifteen medicinal plants which enable them to stimulate the production of maternal milk when a need is expressed.

Keywords: galactagogues; lactation specialist; Medicinal plants; Gontougo region; Côte d'Ivoire 3

Introduction

Infantile malnutrition is a true plague which undermines certain areas of the world. More than 3.5 million children less than five years old and women die each year in the developing countries because of malnutrition issues [1]. It constitutes a complex prob-

lematic which affect the cognitive and physical development of the child, reduces its chances of survival and erodes its economic and social development [2]. West and Central Africa remain the areas of the world which record the highest rates of malnutrition and infant mortality [3]. In 2006, West Africa registered more than 40 % infant deaths in Africa [4]. In Côte d'Ivoire, more than 29 % of children aging under five years still suffer from growth delay, emaciation and ponderal insufficiency. The national prevalence of acute malnutrition is 7.5 %. If malnutrition is considered to be precarious at the national level, it is critical in

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the areas of Bounkani and Gontougo (Tanda, Bondoukou) with a rate range of 10 to 11% [5]. To face this situation, Côte d'Ivoire issued the year 2015 "year of breast-feeding". This policy aims at promoting exclusive breast-feeding during the first six months of the life as recommended by the World Health Organization (WHO) [6]. However, the defect of lactation which occurs in general a few weeks after childbirth strongly hampers this strategy of fight. Agalactia is pathology for which women search for solutions as well in modern as in traditional medicine [7].

Galactagogues act in general on the nervous system by stimulation of prolactin secretion [8]. They are frequently prescribed for the initiation or the increase in lacteal secretion fall, for the breast-feeding of an adopted baby and to start again lactation after an early weaning. In traditional medicine, several medicinal plants are widely used for their galactagogue properties because in rural areas breast-feeding is the only way to nurse. However, information and experience sharing on these plants remain very insufficient. Many research works related to these plants contributed to the improvement of infant health. Studies carried out by Gbadamosi et al [9] made the synthesis of knowledge on the galactagogue plants and their uses. Other works served to list the main galactagogue plants used in the bordering soils of the cynegetic Zone of Pendjari [10]. In Côte d'Ivoire, some works mentioned traditional use of certain plants likely to support the production of milk in the nursing mothers [11].

Although the galactagogue plants are employed in Côte d'Ivoire, there is very little scientific information concerning them. Consequently, a great number of these plants remains unexploited or insufficiently exploited. Thus, the identification of the galactagogue plants through ethnobotanic studies remains a requirement. The objective of this work is to inventory the galactagogue plants employed in the town of Tanda through an ethnobotanic investigation.

Material and Methods

Ethnobotanical investigation area

The present study proceeded in the town of Tanda situated in the Department of Tanda (Area of Gontougo, East of Côte d'Ivoire) (Figure 1 Location of the inventory sites). The Department of Tanda is located between the latitudes 7° 48' 12.06" North and longitudes-3° 10' 5.95" West. It is limited by the Departments of Bondoukou at the Northern side, Transua at the Eastern side, Koun-FAO at the Southern part and Sandégué at the Western border. The local population is mainly composed of Koulango and Brong people completed by immigrants and aliens coming from all the areas of Côte d'Ivoire and West African subregion. This present work took place only in all the villages of the town of Tanda (town of Tanda and 15 villages).

The identification of the visited localities was guided by a nonprobabilistic choice based on the accessibility of the localities of the town of Tanda.

Material of study

The material of study is composed of a technical material used to collect, to inventory and to identify samples on the one hand, and a biological material on the other hand.

The technical material was used for collection of information and samples, and also for conservation and identification of samples. Questionnaires, secateurs, a machete, newsprints, folders, a digital camera (14 méga pixels) and a motorbike for movements were used.

Medicinal or food plants which are used to induce lactation constituted the biological material. They are grasses, shrubs and trees. For the majority of these plants, leaves, stems, seeds or the whole plant were proposed.

Informants and specimen collection of galactagogue plants

Sampling was carried out so as to inventory the galactagogue plants according to the method described by Béné et al [12]. A survey was realized in February 2016 and was implemented near various actors of traditional medicine. According to inclusion and exclusion criteria, 47 of these actors were chosen in a total number of 53 identified in the town of Tanda. These 47 informants were considered, renowned and benefited from the confidence of the local populations. They were all adults and they voluntarily consented to be investigated. For these populations, they have practised traditional medicine since their tender childhood and learned this practice near their parents or a master. This investigation required a questionnaire. In this questionnaire, age of informants, vernacular name of species, the part of the plant used, the modes of preparation and administration of the medical recipes were mentioned. The questions were asked in the local languages (Koulango or Brong). According to circumstances, the services of an interpreter were sometimes necessary. The talks were led on the one hand in the neighbourhood of the village in the presence of the healer. In this case, the plant species indicated were collected immediately. On the other hand, if the informant is too old or occupied, the medicinal plants were collected by his pupil and were presented to the master for authentication. One month after the collection of the samples, each actor was visited a third time in order to express gratefulness and to encourage each of them to collaborate for further studies. The interview questions can be found in the Additional file 2.

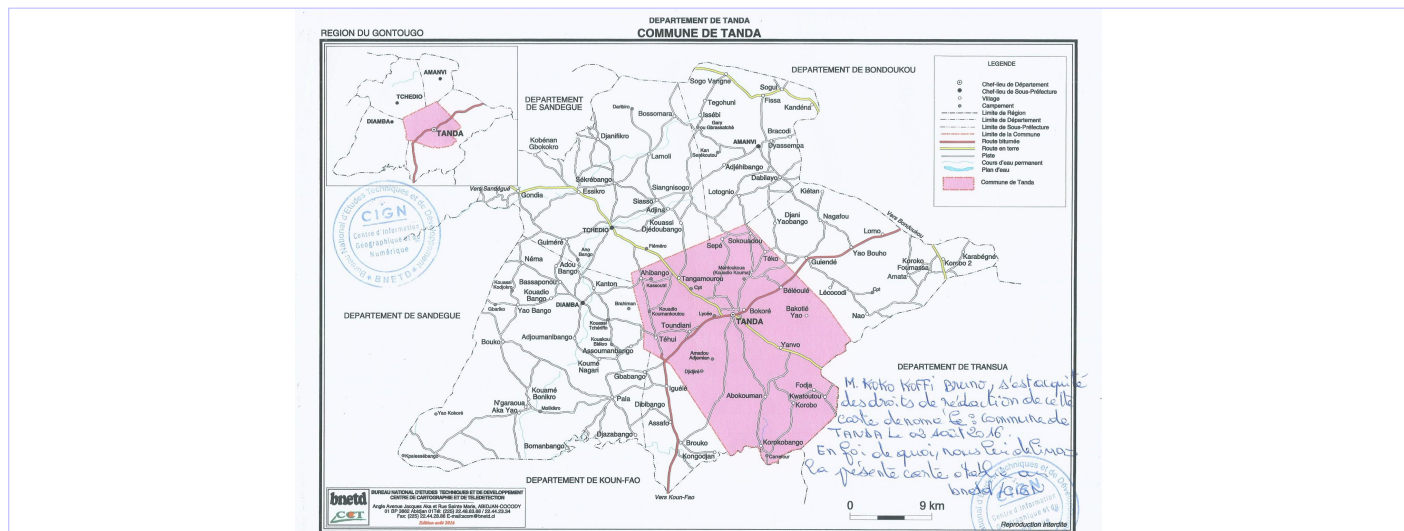


Figure 1 Location of the inventory site. Themap was edited by the legal institution BNEDT (National Technical Studies and Development Office) which authorized its use

Identification of the collected medicinal plants

For each plant proposed, fresh samples were collected. Then, herbaria were made from the place of harvest. After the sampling and the herbaria confection, identification of the plant species was made by an expert (Dr. Aké Assi Emma) of the National Floristic Centre (CNF) at the Université Felix Houphouët-Boigny (Abidjan, Côte d’Ivoire).

Fidelity Level determination of the listed plants

The species most known and used by the populations were determined according to the method suggested by Togola et al [13]. This method allows the classification of the plants according to their Fidelity Level (FL).

$$FL = (Np/N) \times 100$$

Np: Number of use reports for a given species in the treatment of a specific main ailment

N: Total number of informants who mentioned the same plant for any ailment.

Data analysis

The charts were achieved by the software GraphPadPrism 7 (Microsoft, San Diego California, USA).

Results

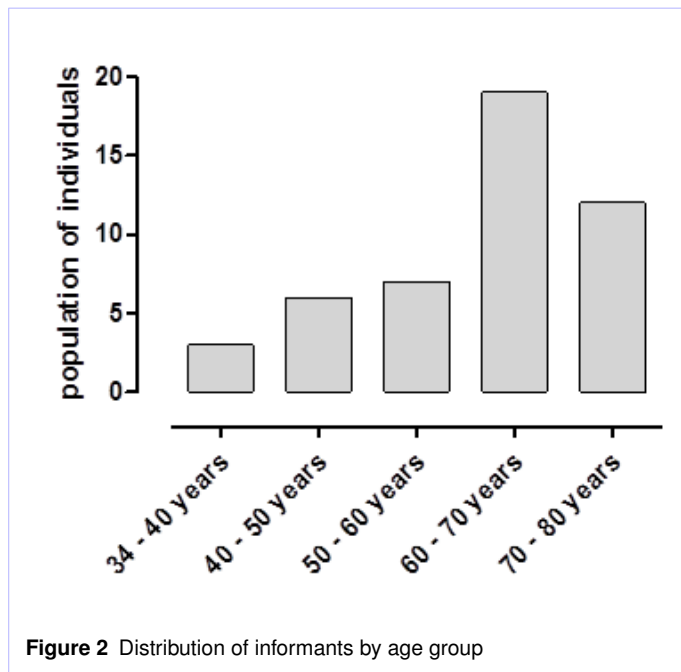
Actors of traditional medicine met

Various actors of traditional medicine were counted during the ethnopharmacological investigations carried out in the town of Tanda. As shown in **Table 1** Distribution of informants, the re-

sults indicated that perfect knowledge of the galactagogue plants was held by women at 70.21 % and 29.79 % by men. These people were divided in four (4) categories of actors according to their know-how. First, there were 19 matrons who represented 40.42 % of respondents. These matrons were women able to help parturients give birth and produce milk using medicinal plants. Then, healers (13) and the "specialists in lactation" (8) followed with respective rates of 27.66 % and 17.02 % of informants. These "specialists in lactation" were women recognized like specialized people within certain families to solve only the problems of maternal milk production. Finally, 7 salesmen of medicinal plants representing 14.90 % closed the list of respondents. These actors of traditional medicine were well-known and recognized by the populations of the town of Tanda. They were people of any kind and whose age varied from 34 years to more than 70 years old (**Figure 2** Distribution of informants by age group).

Ethnomedicinal inventory of the galactagogue plants

Fifteen (15) plant species were traditionally used by the healers to stimulate lacteal secretion in the town of Tanda (**Table 2** Modes of preparation of medicinal recipes). The plants mentioned by informants were classified in 14 genera and 12 families. Fabaceae (2 genera, 13.33 %), Laniaceae (2 genera, 13.33 %) and Asteraceae (2 genera, 13.33 %) were the three (3) families the most represented. Nine (9) other families were represented each one by a species. All the medicinal plants were employed exclusively to increase milk production for nursing mothers except *Ocinium canum* (Laniaceae) which was used to treat the bacterial infections of glands. Indeed, young mothers

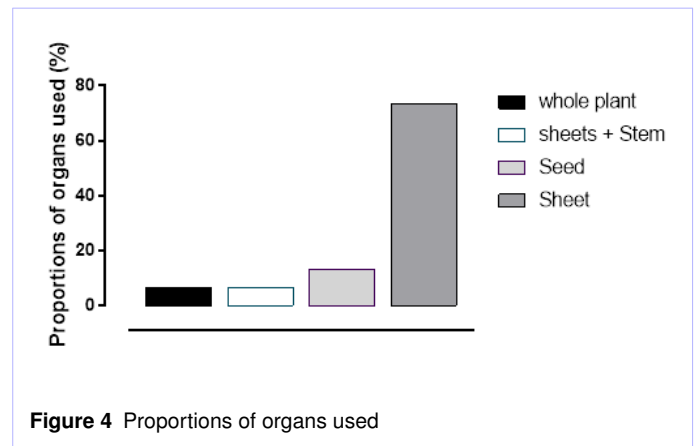
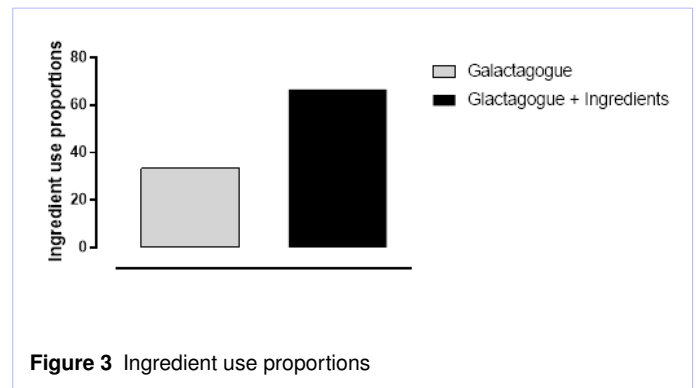


were generally confronted with cases of infection of mammary glands which they recognized and indicated by "Presence of micro-organisms in the breasts ". Statements of these experts of traditional medicine confirmed that this affection was very recurrent in young mothers and could be at the origin of an induration of the mammary glands generally leading to agalactia.

Ethnomedicinal preparations resulting from the galactagogue plants

For the preparation of the medicinal receipts, 66.67 % of these medicinal plants were combined with biological or mineral ingredients (pepper, meat, vegetables, ash, kaolin...) whereas 33.33 % were not combined (**Figure 3** Ingredient use proportions). The whole plant or some parts of these galactagogue plants (leaves, stems, and seeds) were used separately or in association. The leaves and the seeds were the parts the most employed. These organs (leaves and seeds) used separately and not associated with other organs of galactagogue plants represented 73.33 % (11 plants for the leaves) and 13.33 % (2 plants: *C. esculentus* and *A. hypogaea* for the seeds) of listed plant species. As for the association of the stem and the leaves, only one plant (*M. pyrifolia*) was concerned representing 6.67 % of the identified plants. Finally, only one plant (*E. alsinoides*) was entirely used rating 6.67 % of the listed medicinal plants (**Figure 4** Proportions of organs used).

Certain plants were used for the preparation of crushings, sauces and decoctions corresponding respectively to 66.67 %, 13.33 % and 6.67 % of the medicinal recipes suggested. Other



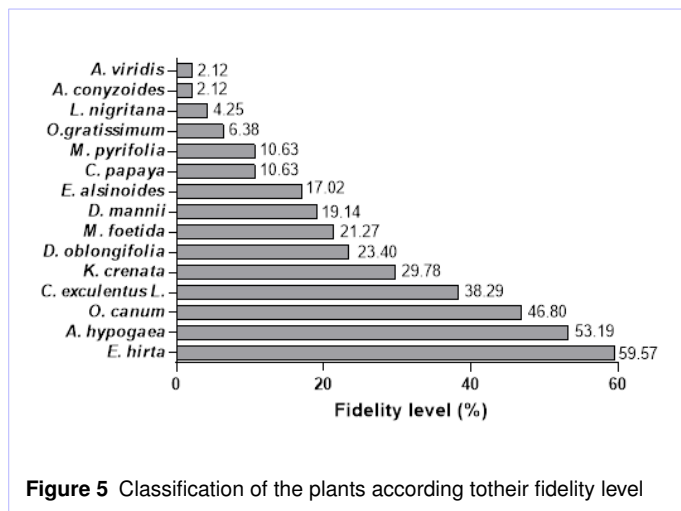
plants (seeds of *C. esculentus* and *A. hypogaea*) were consumed directly as collected. This last group represented 13.33 % of the galactagogue plants revealed by the actors of traditional medicine surveyed in the town of Tanda (Table 3). Cutaneous and oral routes were the ways of administration of the medicinal recipes. The topical application of crushings on the mammary glands (cutaneous way) constituted the principal route of administration of the medicinal recipes. It represented 66.67 % of the medicinal preparations. These crushings (mixed with ash, kaolin, shea butter or not) were directly applied to mammary glands by rub. 33.33 % of the medicinal recipes (decoctions, sauces and direct consumption of seed) were taken by the oral way. Thus, 10 medicinal plants were prescribed to be applied topically whereas 5 medicinal plants were used orally.

Classification of the plants according to their Fidelity Level

The Fidelity Level of each plant was determined in this ethnobotanic investigation (**Figure 5** Classification of the plants according to their fidelity level). These plants were divided into several groups. *E. hirta*, *A. hypogaea* and *O. canum* were the most used galactagogue plants (first group).

Table 1 Medicinal recipes and administration mode

Medicinal recipes		Rate (%)
Presentation	Crushing	66.67
	Source	13.33
	Decoction	6.67
Mode of Administration	Chewing	13.33
	Dermal	66.67
	Oral	33.33

**Figure 5** Classification of the plants according to their fidelity level

They were advised respectively by 59.57 %, 53.39 % and 46.80 % of informants. The second group was composed of *C. esculentus*, *K. crenata*, *D. oblongifolia* and *M. foetida*. These plants were mentioned respectively by 37.17 %, 29.78 %, 23.40 % and 21.17 % of respondents. Eventually, the third group contained 8 galactagogue plants urged by less than 20 % of informants.

Discussion

The ethnopharmacological studies carried out in the town of Tanda permitted to count fifteen (15) galactagogue plant species distributed into 14 genera and 12 families. Another study of this kind revealed twelve (12) medicinal plants employed for their galactagogue virtues [14]. The listed plants were clustered in three dominating families which were: Fabaceae (2 species, 13.33 %); Lamiaceae (2 species, 13.33 %) and Asteraceae (2 species, 13.33 %). This result perfectly corroborated those obtained by Bussmann and Glenn [15]. These authors stipulated that Asteraceae, Lamiaceae and Fabaceae constituted the families of medicinal plants the most used in Peru by women to increase their performances of reproduction. The diversity of galactagogue plants in the town of Tanda confirmed the determination of the rural populations to promote breast-feeding [11]. In

the search for solution to the problems of the defect of lactation, women were the most active. Indeed, they possessed 70.21 % of the knowledge related to the traditional use of galactagogue plants. This result is supported by Bouayyadi et al. [16]. It is however different to the works of Ahmed [17] which indicated that information relating to the traditional use of plants in the province of Sulaymaniyah (Iraq) could be held at 80 % by men. The studies completed by Adepo et al. [11] in various localities of Abidjan, proved that 95 % of women admitted to have used galactagogue plants. Towns and Andel [7] stressed that 85 % of women questioned in Benin acknowledged that they have employed plants to stimulate production of milk. In this study, the information brought by the women were mainly held by matrons and specialists in lactation. The specialists in lactation existed in almost each visited village. They were mothers who received in heritage knowledge related to the use of galactagogue medicinal plants. In general, the medical recipes suggested by these women were always accompanied by mystical practices that potentiate, according to them, the effect of the plant. The specialisation of women in the search for solution to the defect of milk production, shows on the one hand the impact of infantile malnutrition in that locality and on the other hand the will of mothers to fight for each infant to reach adulthood. The determination of mothers to guarantee infant a good nutrition could be explained by the fact that mother and infant constitute an indissociable biological and social unit. Thereby, health and nutrition of the infant could not be separated from those of the mother [7]. One of the difficulties encountered by the nursing mothers was the induration of the mammary glands leading sometimes to a bacterial infection. Descriptions made by traditional medicine actors met referred to cases of lactational mastitis. Mastitis is an inflammatory pathology of breast which can be followed or not by an infection. It generally occurs during the first three months of the postpartum mothers. Limitation of frequency or duration of suckings and obstruction of galactophorus ducts generally lead to a venous stasis which constitutes the principal cause of lactational mastitis. Thus, the stagnation of milk induces an induration of breast and creates a medium favourable to bacterial development [18]. In the treatment of this pathology only one plant was mentioned. It was the species *Ocimum canum* (Lamiaceae).

This plant is famous in various pharmacopoeias for its antibiotic properties. According to the works achieved by Ntonga et al. [19], *Ocimum canum* (Lamiaceae) could inhibit effectively the development of *Plasmodium falciparum*. These works could at least indicate the traditional use of this plant by Koulango and Brong people in the treatment of microbial infections and so bacterial infections of the mammary glands. Different parts of plants such as leaves, stem, seeds and even the whole plant endowed with galactagogue properties were used. Among these parts, the leaves were the most employed with 73.33 %. The same observation was made by Cadena-González et al. [20]. That can be explained by the fact that the leaves are the organs of the plant which are easy to access and manipulate. They are also the centre of photosynthesis and sometimes storage of the secondary metabolites responsible for the properties of the plant. These arguments could explain the predominant use of the leaves in traditional medicine [21]. The direct administration of the medicinal preparations on the skin (mammary glands), constituted the most common route of administration with 73.33 %. This result is in conformity with that of El Hilah et al. [22]. These authors pointed out the direct application of the medicinal receipts on the skin by rub as one of the principal ways of treatment of dermatological affections. To understand the reasons for which rub of mammary glands was the principal method employed to solve problems of defects of milk production, a main reason was evoked. Indeed, rural populations perceive the mammary glands as organs which function in autonomous way and which are able to initiate and to control the production of milk without the intervention of the nervous system. Thus, they thought that a direct application of medical recipes on mammary glands would have the most effective therapeutic action as compared to drinkable solutions. To stimulate the production of milk, each actor met prescribed medicinal species according to the interest he attached to them. Fifteen (15) medicinal plants were listed in this study. These plant species can be classified according to their Fidelity Level. Seven (7) plants had Fidelity Level higher than 20 % and can be regarded as the most used plants. *Euphorbia hirta* (Euphorbiaceae) was the plant species the most employed by mothers in the locality of Tanda (Côte d'Ivoire) for its galactagogue properties. Another study reported that it was only *Euphorbia hirta* (Euphorbiaceae) and *Euphorbia Moss ambicensis* (Euphorbiaceae) which were used in the district of Muleba (Tanzani) for their galactagogue properties [23]. Among the species quoted above, *Euphorbia hirta* was one of the species which sprouted everywhere in villages and in the neighbourhoods of dwellings. This accessibility could partly explain the common use of this plant. Apart from *Euphorbia hirta*, the most used species were respectively *Arachis hypogaea* (Fabaceae); *Ocimum canum* (Lamiaceae); *Cyperus escu-*

lentus lativum (Cyperaceae); *Kalanchoe crenata* (Crassulaceae); *Dalbergia Oblongifolia* (Fabaceae); *Momordica foetida* (Cucurbitaceae). Some works mentioned the traditional use of these plant species in Côte d'Ivoire to ensure good development of pregnancy [24, 25]. This development involved good health of the foetus and good development of mammary glands for the production of milk.

Conclusion

This study permitted to inventory the medicinal species used by Koulango and Brong people to promote breast-feeding. The results showed that fifteen (15) plants were used in the town of Tanda for their galactagogue properties. *Euphorbia hirta* (Euphorbiaceae) was the most used galactagogue plant whereas *Ocimum canum* (Lamiaceae) was the only plant species employed to treat agalactia. The medical preparations were mainly crushings. The topical application of the crushings on the breast by rub (cutaneous way) was the principal route of administration of the medicinal preparations. Other studies are however necessary to justify the traditional therapeutic use of these plants.

Abbreviations

BNETD: National Technical Studies and Development Office; CNF: National Floristic Centre; FAO: Food and Agriculture Organization of the United Nations; FL: Fidelity Level; WHO: World Health Organization.

Ethics approval and consent to participate

Individual verbal consent to participate in the study was obtained prior to implementing the questionnaire. We explained the objectives of the research to each respondent. We assured them that their information was anonymous and that it was only for research purposes. Only individuals that consented to participate in the study were considered.

Competing interests

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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Authors' Contributions

BKK proposed the research idea, collected the data from the respondents, organized the data in computer, did the analysis, interpretation and wrote the manuscript. BAK proposed the research idea, collected the data from the respondents, organized the data in computer, did the analysis, interpretation and wrote the manuscript. JMKG collected the data from the respondents. FKAK collected the data from the respondents. JAK collected the data from the respondents. LKK revised the manuscript for scientific content and did the language check. AKA revised the manuscript for scientific content and did the language check.

All authors read and approved the final manuscript.

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