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Edible plants used during pregnancy and how they contribute to supporting the health of mother and foetus – a study in Northern Ghana

Abstract

Normal growth and development of the foetus during pregnancy are dependent on the general well-being of the expectant mother since she is the source of all the nutrients the foetus requires. Using a semi-structured questionnaire, data was collected from 370 self-confessed pregnant women from 28 randomly sampled suburbs of Tamale, the only city in northern Ghana to ascertain edible plants they use for preparation of meals during their period of pregnancy and the purposes for which they use these plants. Eighteen plant materials were reportedly used by these women for culinary purposes during pregnancy with the processed fermented seeds of *Parkia biglobosa* (Dawadawa), leaves of *Amaranthus cruentus, Corchorus olitorious, Hibiscus sabdariffa*, and the rhizome of *Zingiber officinale* being used by more than 70% of the respondents. However, Garlic (*Allium sativum*) and Ginger (*Zingiber officinale*) were the most used plant materials. The most important plant families were Malvaceae (23.0%) and Fabaceae (17.0%). Provision of good health and vitality, source of nutrients, and serving as a blood tonic were the most common reasons for the use of these plant materials for cooking and preparation of local beverages but *Allium sativum* was reportedly used to spiritually protect the pregnancy. Results of proximate analysis and pharmacological experiments from literature support the various purposes for which these women were using these plant materials as they are found safe for the health of mother and child and do not pose any danger to their health. There is currently no publication on culinary plants used among pregnant women from northern Ghana which in the Guinea savanna ecological zone different from that of southern Ghana. This study should increase advocacy for the increased use of these edible plant materials among pregnant women which can lead to a reduction in maternal and child mortality in Ghana.

Keywords: pregnancy, culinary, food, edible, plants, health, Ghana

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Introduction

Continuation of the human race is possible only through the reproductive process through which women become pregnant. In Africa and other parts of the world, childbirth brings a lot of joy to families since the family lineage is assured of continuing existence.[1,2] During pregnancy, the mother is the source of all the nutrients the foetus requires for growth and development while in the womb and these nutrients are mainly from the food the mother consumes.[3,4] The nutrients present in the human diet are broadly classified as macronutrients which include carbohydrates, proteins, and fats while vitamins and minerals referred to as micronutrients are usually required in small quantities for normal bodily functions.[5] The period of pregnancy increases the material requirement of most of these nutrients and the lack of these nutrients has been found to affect both the physical and intellectual development of the child even into adulthood.[3,6] In poor and developing countries where not all women visit antenatal clinics during pregnancy due to several reasons including poverty, lack of knowledge, or inaccessibility to health facilities or personnel, the use of wild plants either as medicine or for the preparation of food can greatly assist in providing them with plant-based nutrients that would safeguard the health of the mother and child..[6,7] Whereas staple foods in most African countries can provide them with macronutrients, the presence of the micronutrients in these food items may not be adequate hence exploitation of available non-staple plant materials should be able to provide pregnant women with sufficient micronutrients.[6,8] It is severally reported that pregnant women in Africa use either pre-packaged or raw plant preparations as medicines to manage several conditions associated with the pregnancy.[9,10] Instead of using herbal preparations, women also use plant materials during pregnancy for cooking food or preparation of beverages to provide them with nutrients and treat pregnancy-associated symptoms.[11,12] Sometimes, pregnant women use plants not for nutritional purposes but for seasoning their foods such as soups to provide a preferred flavour, aroma, texture, or appearance all of which may be influenced by cultural values or even personal preferences.[13] Edible plants can be considered as eatable plants which have a fundamental role in the provision of nutraceutical elements through diet as well as other substances that can prevent ailments.[14] Culinary uses of plants as spices or condiments is an old practice and can be influenced by the availability of the product in the locality.[15] According to Appiah et al., Ghana with a total land area of 238,533 km^2, has been can be divided into seven ecological zones based on their vegetation types, annual precipitations, and types of principal plant and animal species.[16] These ecological zones are Savannah (Sudan, Guinea, and Coastal), Forest-Savannah Transitional Zone, Semi-Deciduous Forest Zone, Moist Evergreen, and Wet Evergreen (Rain Forest Zone). The flora that dominates these ecological zones and the roles they play in the lives of persons who inhabit these areas may not be the same. Plants provide various ecosystem services including their roles as sources of macronutrients and micronutrients which are required for the growth and development of humans especially during pregnancy when the need for these nutrients increases several fold to supply the needs of the unborn child and the mother. Various parts of edible plants are used in Ghanaian homes as food, medicine, and in the preparation of food, some which which may be added as

spices or as an important component of the food.[12,13] Some studies have been conducted in southern Ghana on the herbs, and spices used by women. However, there is currently no published material on the situation in Northern Ghana which is also the poorest part of the country. Again, there is a paucity of information on the plants used for culinary purposes among pregnant women and the purposes for their use. This study, therefore, identified plants used by pregnant women for culinary purposes in Tamale, and the reasons for their usage. The authors then explored literature to assess the appropriateness of the use of these plant materials and whether some components of these plants may endanger the life of the unborn child.[14–16]

Method

Study design

A cross-sectional quantitative study involving self-confessed pregnant women was undertaken between 4th May and 5th June 2017 in the twenty-eight (28) suburbs of Tamale, the only city in northern Ghana.

Study location

Lying between latitudes 9º16 and 9º 34 North and longitudes 0º 36 and 0º 57 West, the Tamale metropolitan area covers a total estimated land size of 646.9 km^2.[17] There are 115 suburbs in the metropolis out of which 28 were randomly selected for the study. These suburbs include Poluyafong, Police barracks, Gumani, Sakasaka, Biwater, Sabon Zongo, Sabongida, Kakpayili, Sheshigu, Kalpohin Estate, Wamale, Lamashegu, Gurugu, Tunaayili, SSNIT, Lamankara, Kukuo, Zogbeli, Bilpela, Jisonaayili, Tishegu, Sognaayili, Sagnarigu kukuo, Choggu Yapelsi, and Nyashegu (Figure 1). The main vegetation of the Northern region where the Tamale metropolitan area is located is grassland, interspersed with the guinea savannah woodland, dominated by drought-resistant trees such as the acacia, baobab, shea nut, dawadawa, mango, and neem.[18]

Figure 1 Map of the Tamale metropolitan area showing the study areas.

Study sample size determination

The Cochran sample size calculation formula for the infinite population as cited in Bartlett et al.[19] was used since it was not possible to get an accurate number of pregnant women in the Tamale metropolis at any time.

$$N = \frac{z^2 pq}{d^2}$$

n= the desired sample size,

z = the selected critical value of desired confidence level, which is 1.96 at 95% confidence interval,

p= proportion in the target population estimated to have a particular characteristic.

A previous study in Nigeria by Duru et al., reported almost 40% of pregnant women used plants for various health purposes,[20] hence p = 0.4.[20]

d, the degree of accuracy = 0.05

$$n = \frac{(1.96)^2 \times 0.4 \times 0.6}{(0.05)^2}$$

$$= \frac{3.841 \times 0.4 \times 0.6}{0.0025}$$

Sample size, n =368.73 approximately 370 respondents

Sampling procedure

Microsoft Excel was used to randomly select 28 out of the 115 suburbs from which 14 self-confessed pregnant women were each conveniently selected to make up the 370 total respondents. On getting into a suburb, the researchers entered the nearest home and asked for any woman in the house and politely questioned if there was a pregnant woman at home. In situations where there is none, the researchers moved to the closest house until a qualified respondent was found. Snowball sampling was then used to get to the next available pregnant woman in the neighbourhood.

Data collection tools and techniques

The study tool, a semi-structured questionnaire was found appropriate to be for the study after piloting among 20 women in Dungu, a suburb of Tamale near the University for Development Studies. Whereas the interview guided by the developed questionnaire was conducted among illiterate respondents, eligible women who could read and write completed the study tool themselves. Again, for the illiterate respondents, the questions were translated into the language such respondents best understood which were mainly Dagbanli, Hausa, and Twi. The questionnaire had sections that recorded the socio-demographic characteristics of the respondents while other sections obtained data on the plants they used for culinary purposes since they got pregnant. We considered edible plants for culinary during pregnancy as raw plant materials which became an important component of the ingredient used during the preparation of sauces and soups or used to prepare beverages in the form of teas after conception. We undertook a literature review of peer-reviewed articles for information on the nutritional or phytochemical components of the top ten plants based on their relative frequency of citation. We also sought to find out if these plants contain harmful constituents or produce adverse effects which are unsafe during pregnancy. Based on this information, we were able to suggest the appropriateness or otherwise of the plants that these participants in the study use during pregnancy and how these nutrients can support the health of the mother and the foetus.

Search engines, Google and Google Scholar were used by keying in the names of the plants in combination with keywords 'pregnancy',' culinary', 'edible', 'plants', 'food', 'edible', 'nutrition', 'adverse effects', 'health' and 'Ghana'. All scientific plant names were checked with The Plant List (www.theplantlist.org)

Ethnobotanical index - relative frequency of citation (RFC)

The RFC is obtained by dividing the number of informants indicating the use of a species (Fc) by the total number of participants in the survey (N). [21] Fc, the indication of the use of species is the same as the number of citations.

RFC=Fc/N

Statistical analysis

Microsoft Excel was used to store the data and also for the analysis. Whereas some results were presented as a pie chart, others were in tables that showed frequencies, percentages, and relative frequency of citations.

Ethical consideration

All ethical considerations were operationalized during the study without infringing on the rights of the respondents. Also, during the collection of the data, respondents were spoken to in languages they best understood and made to appreciate that the study was for academic purposes and will in no way infringe upon their rights. They were also told they were at liberty to discontinue responding whenever they felt uncomfortable. Verbal consent was obtained from all the respondents before the data collection started. Again, the introductory section of the questionnaire also indicated to respondents that completion of the questionnaire was presumed to indicate consent to the study.

Results

Demographic characteristics of respondents

Table 1 shows the demographic characteristics of respondents. The majority, 196 (53.0%) of the pregnant women were between the ages of 21 and 30 years, 314 (84.9%) were married, 210 (56.8%) were in nuclear families, 188 (50.8%) were self-employed and 239 (64.2%) were followers of the Islamic religion. Most respondents, 119 (32.2%) had up to senior high school level education, and 166 (44.9%) lived in a chamber and a hall type of accommodation which is indicative of they being low income earners.

Table 1 Demographic characteristics of respondents

Variable	Subgroup	Frequency	Percentage
Age (years)	10 – 20	26	7.0
	21- 30	196	53.0
	31- 40	135	36.5
	41 – 50	13	3.5
Marital status	Single	39	10.5
	Co-habitant	17	4.6
	Married	314	84.9
Religious affiliation	Christianity	125	33.8
	Islam	239	64.2
	Traditionalist	6	1.6
Educational level	None	73	19.7
	Basic	92	24.9
	Secondary/Vocational	119	32.2
	Tertiary	86	23.2
Family type	Nuclear	210	56.8
	Extended	160	43.2
Type of employment	None	69	18.6
	Self-employed	188	50.8
	Private	49	13.2
	Government	64	13.2
Type of accommodation	Single room	133	35.9
	Chamber & Hall	166	44.9
	Apartment	69	18.6

Relative frequency of citation of culinary plant materials used by respondents during pregnancy

Various plant materials mostly leafy vegetables were used in the preparation of food used by pregnant women in this study (Table 2). A total of 18 plant materials were identified as used for various purposes during pregnancy and found in their food or beverages. Out of the 18 plants, the part used mostly was the leaves, 11 (61.1%). The top 10 most used plants for culinary purposes based on their relative frequency of citation were: African locust beans *(Parkia biglobosa*; 0.786), Amaranth (*Amaranthus cruentus*; 0.768), Jew's mallow (*Corchorus olitorious*; 0.711), Ginger (*Zingiber officinale*; 0.692); Roselle (*Hibiscus sabdariffa*; 0.614), Garlic (*Allium sativum*; 0.514), Beans (*Vigna unguiculate*; 0.481); Baobab (*Adansonia digitata*; 0.427), Moringa (*Moringa oleifera*; 0.397) and Cassava (*Manihot esculentum*; 0.392).

Table 2 Plants used for culinary purposes by respondents during pregnancy and their relative frequency of citation

Common/ (local name)	Scientific name	Family	Parts used	Number of citations (n = 370)	Relative frequency of citation
African locust beans (Dawadawa)	*Parkia biglobosa* (Jacq)	Fabaceae	Fermented seeds	291	0.786
Amaranth (Aleefi)	*Amaranthus cruentus* L.	Amaranthaceae	Leaves	284	0.768
Jew's mallow (Ayoyo)	*Corchorus olitorious* L.	Malvaceae	Leaves	263	0.711
Ginger (Kakaduro)	*Zingiber officinalis* Rosc.	Zingerberaceae	Stem	256	0.692
Rossele (Bra)	*Hibiscus sabdariffa* L.	Malvaceae	Leaves	227	0.614
Garlic	*Allium sativum* L.	Liliaceae	Bulb	190	0.514
Beans (Bangli)	*Vigna unguiculate* L.	Fabaceae	Leaves and seeds	178	0.481
Baobab (tukari)	*Adansonia digitata* L.	Malvaceae	Leaves	158	0.427
Moringa (arizandatia)	*Moringa oleifera* Lam.	Morigaceae	Leaves and seeds	147	0.397
Cassava (Bankye)	*Manihot esculenta* Crantz.	Euphorbiaceae	Leaves	145	0.392
Bitter leaf(shuaka)	*Vernonia amygdalina* Del.	Asteraceae	Leaves	131	0.354
Cocoyam (Kontomire)	*Xanthosoma sagitifolium* (L.) Schott.	Araceae	Leaves	14	0.038
Okro (Mana)	*Albelmoschus esculentus* (L.) Moench	Malvaceae	Leaves, fruits	11	0.030
Turkey berry (Kwahu nsusua or Abe duro)	*Solanum torvum* Sw.	Solanaceae	Fruits	9	0.024
Cabbage	*Brassica oleracea* L.	Brassicaceae	Leaves	3	0.008
Aridan (Prekese)	*Tetrapleura tetraptera* (Schumach. & Thonn.) Taub.	Fabaceae	Fruit	1	0.003
Sesame	*Sesanum africanum* Tod.	Pedaliaceae	Seeds	1	0.003

Families of the plants used by pregnant women as food and beverages

Plants belonging to 12 different families were used by the pregnant women for culinary purposes in this study as shown in Figure 2. The Malvaceae family was the most represented (23.0%) followed by the Fabaceae family (17.0%). All the other families were represented only once (6.0%).

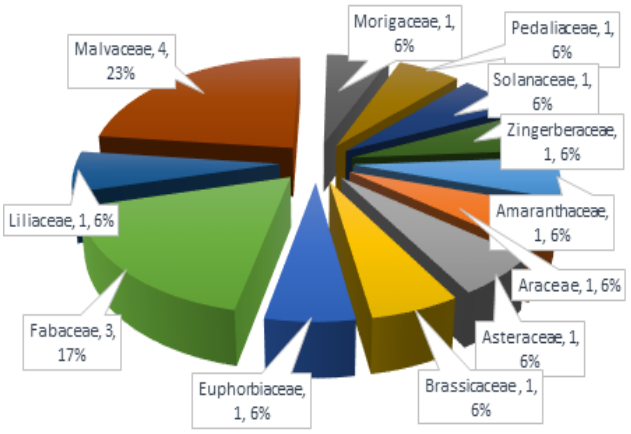

Figure 2 Plant families used by the participants for culinary purposes.

Reasons for the use of some of the edible plants for food and beverages

The most common reason for the use of Ginger (*Zingiber officinalis*) by pregnant women was for the seasoning of their food (44.1%) but up to 19.5% of the women used ginger as a cough reliever (19.5%) management of nausea and vomiting (12.5%), and for their catarrh or cold (9.8%). Garlic (*Allium sativum*) was mainly used for seasoning (35.3%) but also used for the prevention of hypertension (13.7%), as blood tonic (12.6%), and for the provision of general health and vitality (11.6%). Garlic was the plant reportedly used for pain-relieving (4.2%) and for the provision of spiritual fortification (3.2%). Among the plants, the women considered to be blood-producing, Dawadawa *(Parkia biglobosa*) was the most preferred (59.5%). Other blood-producing plants used by at least 50% of the respondents were; *Amaranthus cruentus* - Aleefi (56.3%), *Corchorus olitorious* - Ayoyo (54.8%), and *Hibiscus sabdariffa* - Bra (51.5%). Dawadawa also found some other uses such as the provision of general health and vitality (16.5%), source of nutrients (8.6%), and seasoning of food (5.5%). Other edible plants reported by the respondents to improve their general health and vitality include *Manihot esculenta* - Cassava leaves, (46.9%), *Vigna unguiculate* - Beans leaves (47.1%), *Adansonia digitata* - Boabab leaves (44.9%), *Vernonia amygdalina* - Bitter leaves (33.6%), *Corchorus olitorious* - Jew's mallow (23.6%), *Hibiscus sabdariffa* - Bra (24.3%), *Moringa oleifera* - Moringa leaves (20.4%) as well as *Amaranthus cruentus* - Aleefi (18.0%). Plants listed by more than 5% of respondents as their sources of nutrients include Bra (10.6%), baobab leaves (9.5%), beans leaves (7.3%), and Cassava leaves (5.5%). Other plants mainly used by women that provide some laxative effects include bitter leaves (22.9%), cassava leaves (9.7%), Moringa (8.2%), and beans leaves (7.9%). Majority of Moringa users do so to take care of fever (46.9%) with another 12.2% using it to treat malaria. Bitter leaf was the only other plant reportedly used for fever management (3.8%). The roles of the commonly used edible plants by the respondents are represented in Table 3.

Table 3 Reasons for the use of edible plants in the preparation of their foods

	Zingiber officinalis (Ginger) (n = 256)	*Allium sativum* (Garlic) (n = 190)	*Parkia biglobosa* (Dawadawa) (n = 291)	*Amaranthus cruentus* (Aleefi) (n = 284)	*Corchorus olitorious* (Ayoyo) (n = 263)	*Hibiscus sabdariffa* (Bra) (n = 227)	*Manihot esculenta* (Cassava) leaves (n = 145)	*Vigna unguiculate* (Beans leaves) (n = 178)	*Vernonia amygdalina* (Bitter leaf) (n = 131)	*Adansonia digitata* (Baobab leaves) (n = 158)	*Moringa oleifera* (Moringa) (n = 147)
Analgesic	0 (0.0%)	8 (4.2%)	0 (0.0%)	0 (0.0%)	0 0.0%)	0(0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Preparing local beverages	8 (3.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Antiemetic	32 (12.5%)	4 (2.1%)	0 (0.0%)	0 (0.0%)	0 0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Appetite stimulant	0 (0.0%)	0 (0.0%)	4 (1.4%)	0 (0.0%)	9 3.4%)	12 (5.3%)	0 (0.0%)	0 (0.0%)	7	8	0 (0.0%)
Catarrh/Cold	25 (9.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Antihypertensive	0 (0.0%)	9 (4.7%)	0 (0.0%)	5 (1.8%)	0 0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4	0 (0.0%)
Blood tonic	0 (0.0%)	24 (12.6%)	173 (59.5%)	160 (56.3%)	144 (54.8%)	117 (51.5%)	46 (31.7%)	57 (32.0%)	32	40	7
Cough	51 (19.9%)	8 (4.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Provides good health and vitality	15 (5.9%)	22 (11.6%)	48 (16.5%)	51 (18.0%)	62 (23.6%)	55 (24.3%)	68 (46.9%)	84 (47.1%)	44	71	30
Laxative	0 (0.0%)	0 (0.0%)	0 (0.0%)	9 (3.2%)	4 (1.5%)	7 (3.1%)	14 (9.7%)	14	30	7	12
Others	12 (4.7%)	9 (4.7%)	19 (6.5%)	4 (1.4%)	2 (0.8%)	3 (1.3%)	4 (2.8%)	7	5	6	6
Prevention of hypertension or strokes	0 (0.0%)	26 (13.7%)	6 (2.1%)	2 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Seasoning	113 (44.1%)	67 (35.3%)	16 (5.5%)	3 (1.1%)	3 (1.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Source of nutrients	0 (0.0%)	7 (3.7%)	25 (8.6%)	41 (14.4%)	26 (9.9%)	24 (10.6%)	8 (5.5%)	13	5	15	0 (0.0%)
Spiritual purposes	0 (0.0%)	6 (3.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Vegetable	0 (0.0%)	0 (0.0%)	0 (0.0%)	9 (3.2%)	13 (4.9%)	9 (4.0%)	5 (3.4%)	3	3	7	5
Fever	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5	0 (0.0%)	69
Malaria	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	18(12.2%)

Discussion

For females, the most fertile period is in the twenties22 and this was shown in this study whereby than half (53.0%) of the respondents were between the ages of 21 and 30. Almost two-thirds (64.2%) of the respondents ascribing to the Islamic faith is also not surprising since, in the 2010 Population and Housing Census, the Ghana Statistical Service (GSS) reported that 90.5% of the population of the Tamale metropolis were Muslims.[17] Humans just like other living things must feed to ensure their survival but in pregnancy, the woman's diet also provides for the growth and development of the foetus. During the preparation of Ghanaian traditional food, materials some plants are known to be added for various reasons including the provision of characteristic flavours, texture, and taste among others.[13,23] Some pregnant women also add some of these plants to their food and beverages to manage some of the symptoms associated with pregnancy and were seen in this study in which 18 plant materials were listed (Figures 2 to 9). A study in southern Ghana also found women using 32 plants during pregnancy.[12] Although some of these plants in this study were also recorded in this study, there were several differences and this can be attributed to the differences in the ecological zones in southern Ghana which is mainly coastal savanna and forests while Tamale which is in northern Ghana is located in the Guinea savannah ecozone. All the 18 plant materials reportedly used in Tamale for culinary purposes except one (*Manihot esculenta*) were not reported by the other Ghanaian study conducted by Towns and Van Andel 13 This study found plants in the Malvaceae family to be the most used and could be so because they have been found to exhibit several pharmacological properties especially against symptoms that are pregnancy-related and are rich sources of digestible proteins as well as minerals.[24,25] These pregnant women used these plants probably because others recommended these plants to them and they also found them useful. It is also known that some plant materials could also have adverse effects on the foetus causing abortions or malformations due to their teratogenic components.[26–29]. It is therefore important to assess if literature supports the several uses of some of these plants in pregnancy in northern Ghana.

Figure 3 *Zingiber officinalis*.

Citation: Ameade EPK, Zakaria AP, Abubakar L, et al. Edible plants used during pregnancy and how they contribute to supporting the health of mother and foetus – a study in Northern Ghana. *Int J Complement Alt Med.* 2024;17(3):119–133. DOI: 10.15406/ijcam.2024.17.00693

Figure 4 *Parkia biglobosa*.

Figure 5 *Amaranthus cruentus*.

Figure 6 *Corchorus olitorious*.

Figure 7 *Hibiscus sabdariffa*.

Figure 8 *Adansonia digitata*.

Figure 9 *Tetrapleura tetraptera*.

Citation: Ameade EPK, Zakaria AP, Abubakar L, et al. Edible plants used during pregnancy and how they contribute to supporting the health of mother and foetus – a study in Northern Ghana. *Int J Complement Alt Med.* 2024;17(3):119–133. DOI: 10.15406/ijcam.2024.17.00693

Figure 10 *Solanum torvum.*

Ginger (*Zingiber officinalis*)

Ginger, *Zingiber officinale* is a seasoning or condiment as well as herbal remedy used by humans for not less than 2500 years and it has gained worldwide use now. Gadegbeku et al.,[13] found ginger as a seasoning commonly used to prepare food in southern Ghana so its use by more than two-thirds (69.2%) of the pregnant women in this study was not surprising. The use of ginger for food and beverage preparation as well as medicine can be attributed to the about 400 chemical components in it.[30] The components of ginger depend on its state whether is it; fresh or processed but generally the active constituents are mainly phenolic compounds and terpenes while the non-active components are carbohydrates (50–70%), lipids, amino acids, proteins, raw fibres, phytosterols, vitamins (A, B_3, B_6, and C), as well as minerals such as calcium, copper, iron, potassium, magnesium, zinc, manganese, and phosphorus.[30–33] The physiological effects of ginger are provided by the active chemicals including gingerols, shogaols, paradols, quercetin, zingerone, flavonoids, bisabolene, curcumene, zingiberene, farnesene, sesquiphellandrene, zerumbone, among others.[30,34] Almost two-fifths (44.1%) of the women who use ginger for seasoning did so because of the unique aroma and taste of ginger which can be attributed to its volatile components which are mainly sesquiterpenes and monoterpenes.[35] About 5.9% of women in this study use ginger for good health and vitality which can be attributed to the gingerol, shogaol, oleoresin, Vitamin C, and flavonoids that are strong antioxidants as well as the minerals that ensure optimal function and protection of vital organs of the body.[30,36,37] Ginger as a remedy for cough, catarrh, and cold had been recorded in this study just as in several earlier reports with gingerol and shogaol being responsible for this activity.[30,31,38,39] This study found about one-eighth of pregnant women ever used ginger for nausea and vomiting which is corroborated by studies from many other places.[31,40,41] The antiemetic activity of ginger can be attributed to 6-shogaols, 6-gingerols, galanolac¬tone, and zingerone.[42–44] Some women in this study use Ginger to prepare a local beverage sobolo which is prepared using the dried calyces of roselle (*Hibiscus sabdariffa*) in parts of Ghana. [45,46] Some of the mineral components of this roselle beverage which include sodium, magnesium calcium, potassium, iron, zinc, and phosphorus support the health of mother and child.[47] Consumption of ginger did not seem to affect the outcome of pregnancies in several studies although some adverse reports such as headaches, diarrhoea, abdominal discomfort, drowsiness, heartburn, and reflux occurred in some pregnant women.[37,40,41]

Garlic (*Allium sativum*)

The extensive use of garlic for culinary and medicinal purposes has been recorded in ancient writing from countries such as India, Greece China, as well as Egypt.[48] In this study, almost one out of two women used garlic for culinary purposes. The over two hundred chemical substances present in the Garlic bulb include volatile oil containing sulphur compounds such as Ajoene, Alliin, and Allicin, and enzymes; minerals such as iron, copper, magnesium, zinc, selenium, potassium, germanium, and calcium, vitamins A, B_1, C, as well as several amino acids including lysine, histidine, arginine, threonine, proline, glycine, valine, among others, may be responsible for their extensive use by humans.[49] In this study, garlic was the most common plant material used by pregnant women, and in more than a third (35.3%) cases of use, it was for the seasoning of their food. All over the world from Asia, the Middle East, Northern Africa, Australia, and the Americas, ginger is reported to be the indispensable ingredient in the preparation of most dishes just as reported in this study.[50] Gadegbeku et al.,[13] also listed garlic as one of the seasoning materials used in the preparation of food in Ghana. The pungent flavour of garlic which makes it useful as a seasoning material can be attributed to the organosulphur compounds in the bulb.[49] Some pregnant women may be hypertensive at the time of pregnancy hence their use of garlic which had been well documented to possess antihypertensive properties is appropriate.[49,51–54] The use of garlic for general health and vitality, source of nutrients and as a blood-producing plant material can be explained by the presence of several minerals, amino acids, antioxidants and vitamins in the bulb of garlic has been reported.[49,51,53] The iron requirement during pregnancy increases and with garlic as a source of iron, red blood cell formation in mother and child is enhanced thereby preventing anaemia which can endanger their lives.[3,55] The vitamin C has also been found to enhance the absorption of non-haem iron by pregnant women.[3] In 4.2% cases of use, some pregnant women in this study used garlic for the treatment of cough. This cough management effect of garlic has been corroborated in several reports.[49] Among all the edible plants used among pregnant women, garlic was the only one some women used for the relief of pain. This plant has been reported to be used in the treatment of arthritis but there is a paucity of information on its use for general pains associated with pregnancy.[56] Consumption of the garlic bulb even in small quantities is reported to cause nausea and vomiting as an adverse effect hence it is rather paradoxical for its use as an antiemetic by some of the pregnant women in this study.[53] Garlic seems to be the only plant used by women for culinary purposes that provides some spiritual protection for the mother and child. This presumed magical shield against evil spirit had been reported in some previous studies.[57,58] Despite these useful roles of normal amounts of garlic in pregnancy, excessive use of it can cause some unwanted effects such as excessive bleeding during a caesarian section since blood clotting mechanism is affected, stomach upset, bloating, nausea and vomiting, skin rash, fatigue, headache as well as increased episodes of heartburn in pregnancy.[40,51,59]

Dawadawa (*Parkia biglobosa*)

Dawadawa (*Parkia biglobosa*), popularly called African locust bean is native to Africa and is known to be one of the most important West African Savannah land multipurpose trees.[60,61] The tree is mainly grown to collect seed pods that are known to contain nutritious and valuable seeds and as well, its sweet pulp. According to Sackey and Kwaw, (2013), the *Parkia biglobosa* tree is present in both northern and southern sectors of Ghana especially the northerly regions of

Upper East, Upper West, Savanna, North East, and Northern regions as well as Kete Krachi (Oti Region), Ejura (Ashanti Region) and Kwahu (Eastern Region).[62] The seeds of Parkia commonly referred to as "dawadawa" are used as stew and soup seasoners. Before its use for seasoning, the seeds are subjected to fermentation and then moulded into various shapes (Figure 4). With technological advancement, a food processing company Nestle′ Ghana Limited has formulated Royco dawadawa into a seasoning cube.[62] It is therefore not surprising that more than three-fourths (78.9%) of the respondents consume dawadawa which appears to be the most important condiment used during pregnancy in this study. The fermented seeds are used to enhance the flavours of foods during preparation of meals.[63] Volatile and aromatic compounds were also identified in these condiment.[64,65] This may be responsible for the boosting of appetite, especially with the presence of aromatic compounds. Fermented dawadawa seeds are crumbled and put into stews and soups when cooking. It is often referred to as cheese or meat due to its high content of protein and fats and also bears a savoury taste.[66] The fruit pulp is a potential source of energy due to the high natural sugar content it possesses. Nutritional requirements during pregnancy increase and it is no wonder that about 8.6% of pregnant women consumed dawadawa for nutritional reasons. The distinctive yellow pulp indicates the presence of the phytonutrient, most probably carotenoids. This is an important precursor for the production of Vitamin A (retinol). It is also an important source of Vitamin C (ascorbic acid).[67] It contains about 191.20ug/100g of vitamin C[68] which is way higher than the daily recommended intake of 30mg/65kg b.w adult humans and other foodstuff that contain vitamin C.[69] These vitamins potentially contribute to the high antioxidant capacity of the plant which consequently contributes to good health and vitality as reported by 16.5% of the pregnant women in the survey. Vitamin C is very useful in collagen synthesis, facilitates iron absorption, and participates in the biosynthesis of glucocorticoids. Iron is also important in blood synthesis. The iron requirement during pregnancy increases and with dawadawa as a source of iron, red blood cell formation in mother and child is enhanced thereby preventing anaemia which can endanger their lives. 3 The vitamin C has also been found to enhance the absorption of non-haem iron by pregnant women.[3] About 59.3% of pregnant women consumed dawadawa to improve blood supply. The bean also contains about 67.30% carbohydrate making it a potentially good source of energy.[68]

Amaranth (*Amaranthus cruentus*)

Most Amaranthus species have edible leaves, and several species including *A.cruentus (*Figure 5*)* are already widely used as potherbs (boiled greens). Their mild spinach-like flavour, high yields, ability to grow in hot weather, and high nutritive value have made them popular vegetable crops, perhaps the most widely eaten vegetables in the humid tropics of Africa and Asia.[69] Amaranth (*Amaranthus cruentus*) is a priority indigenous vegetable in the Northern Region of Ghana.[70] It is therefore not surprising that *A. cruentus* came out as one of the most consumed vegetables (76.7%) in this survey. It is used mainly as a leaf vegetable, prepared by cooking and consumed as a vegetable dish or as an ingredient in sauces. In Africa, the leaves and tender stems are cooked or fried in oil and mixed with meat, fish, cucumber seeds, groundnut, and palm oil. This is eaten with the main dish of cereals or tubers. The powdered dry leaves are used in sauces during the dry season.[71] Medicinally it is used as follows: for young children and lactating mothers, for treating constipation, anaemia, and kidney complaints, roots are boiled with honey as a laxative for infants, its water extract is used to treat pains in the limbs, as a tapeworm expellant, wound dressing, and tumours and also has antioxidant properties.[72] This agrees with the outcome of this survey where respondents affirmed the usage of *A. cruentus* as blood tonics (56.3%) and laxative (3.2%). Vegetable amaranth has received significantly less research attention than grain amaranth. However, it has been rated considerably higher in minerals, such as calcium, iron, and phosphorous than most vegetables.[73] *A. cruentus* provides balanced forage high in crude protein.[73] The nutritional requirement of pregnant women usually is very high hence the reason for the high consumption during pregnancy as reported in this study 14.4%. The pharmacological properties of different amaranth species also have been investigated. It was subsequently reported that *A. cruentus* possessed lipid-lowering properties, hence, contributing to the alleviation of hypertension.[74] About 18% of women use *A. cruentus* for good health and vitality. It has been reported that the leaves, seeds, and sprouts of *A. cruentus* contain significant amounts of flavonoids typically morin, isovitexin, vitexin, nicotiflorin, isoquercitrin and rutin. It also contains phenolic acids (gallic acid, vanillic acid, syringic and ferulic acids) which have reportedly been identified to contain relatively good amounts of antioxidants.[75] Despite the nutritional and medicinal value *A. cruentus* possesses, it has considerable amounts of hydrocyanic and oxalic acids which render them quite toxic for human consumption. These, however, can be removed by adequate cooking (Figure 5).[76]

Jew's mallow (*Corchorus olitorius*)

Corchorus olitorius leaves are widely consumed in various cultures across various continents in the world, especially in Asia, America, and Africa. It is known to be a popular vegetable consumed in West Africa where they are used to prepare soup or the leaves are boiled and mix it with groundnut cake for consumption.[77] This survey has found that about 4.9% of pregnant women consume this plant. *C. olitorius* leaf as a vegetable which is rich in beta-carotene, Vitamins A, C, and E. Leaves are plentiful in phenolic and flavonoids. All of these can directly contribute to antioxidant actions and are consequently responsible for high levels of antioxidants and antimicrobial activities[78] which accounts for about 23.6% of pregnant women employing this herb for good health and vitality. Moreover, antioxidants have been associated with protection from chronic diseases such as heart disease, cancer, diabetes, and hypertension as well as other medical conditions.[79] Elsewhere *Corchorus olitorius* L. leaves are popularly used in soup preparation and folk medicine for the treatment of fever, chronic cystitis, cold, tumours, as well as to restore appetite and strength.[80] This agrees with the usage as an appetite booster in this survey. *Corchorus olitorius* leaves are well known as an emollient, diuretic, tonic, and for purifying the human body.[81] It has been reported elsewhere to be a blood tonic agent.[82] Also in Bengal, where it is considered a tonic, leaves are used as a condiment, commonly added to the daily diet of rice.[83] This explains why more than half of the pregnant women (54.8%) who consume this herb use it as a blood tonic. Plants provide minerals, vitamins, and positive hormone precursors in addition to protein and energy to the human body.[84] *Corchorus olitorius* leaves are very rich in proteins, β-carotene, iron, calcium, vitamins A, B, C, and E, folic acid, amino acid, and essential minerals.[85] This makes it a choice for pregnant women (9.9%) since their nutrient requirement becomes higher than normal just as the outcome of this survey stated. Despite these huge nutritional benefits, *Corchorus olitorius* like other leafy vegetables, bioaccumulates various antinutrients and toxic substances which has a negative effect on health at high concentrations and thereby underscores the derivable nutritional benefits.[86]

Rossele (*Hibiscus sabdariffa*)

Hibiscus sabdariffa has been widely used in local medicines and is cultivated for its stem, leaves, calyces, and seeds as all parts have industrial, medicinal, and other applications.[87] Fresh juicy and even dried calyces are used in the preparation of beverages, jams, jellies, sauces, cakes, puddings, syrup, and wine.[87] Many parts of roselle including seeds, leaves, fruits, and roots are used in various foods. The young leaves and tender stems of roselle are eaten raw in salads or cooked as greens alone or in combination with other vegetables and/or with meat. They are also added to food as colourants.[88] In India, Africa, and Mexico, infusions of the leaves or calyces are traditionally used for their diuretic, choleretic, febrifugal, and hypotensive effects, decreasing the viscosity of the blood and stimulating intestinal peristalsis.[89] In Ghana, the refreshing drink called sobolo is prepared from the calyx of *H sabdariffa* for its antimicrobial activity.[45] Decoction prepared from the seeds of this plant is used in India to relieve pain in urination and indigestion. In Brazil, the roots are believed to have stomachic and emollient properties. In Nigeria, the decoction of the seeds is traditionally used to enhance or induce lactation in cases of poor milk production, poor letdown, and maternal mortality.[90] Its widespread global use is evident hence its heavy consumption by 61.4% of pregnant women in this study. The calyces and seeds are diuretics, laxatives, and tonics.[89] Coupled with the rich iron content of the plant, it can serve as a tonic, especially in pregnant women who require more blood for the effective development of the foetus. This confirms the wide use by majority pregnant pregnant women in this study (51.5%). A recent study by Serna et al., revealed that *Hibiscus sabdariffa* suppresses appetite however in obese populations, and this contradicts the report of this study which showed that pregnant women 5.3%[12] rely on *Hibiscus sabdariffa* to boost their appetite.[91] Further research ought to be conducted to validate the claim. The nutritional requirement of pregnant women is huge. The nutritional composition of *Hibiscus sabdariffa (*Figure 7*)* has been reported to contain protein, carbohydrates, minerals (calcium potassium, magnesium, iron, and phosphorus), vitamins, and fibre hence their dependency by pregnant women for nutrients is reported to be the reason for consumption by 10.6% of the pregnant women.[92–94] *Hibiscus sabdariffa* is also rich in b-carotene, calcium and iron, thiamine, riboflavin and ascorbic acid.[95] The red calyces contain antioxidants including flavonoids, gossypetine, hibiscetine, and sabdaretine. These elements contribute to the enormously antioxidant abilities of *Hibiscus sabdariffa*. Moreover, *Hibiscus sabdariffa's* antioxidant bioactivity in rat primary hepatocytes and hepatotoxicity was established by Wang et al.[96] Antioxidants generally have been known to be associated with protection from chronic diseases such as heart disease and cancer as well as improve general health and vitality.[97] Hence, this agrees with its use by 24.3% of pregnant women in achieving good health and vitality in this research. Roselle is used in many folk medicines. It is valued for its mild laxative effect and for its ability to increase urination, attributed to two diuretic ingredients, ascorbic acid, and glycolic acid.[98] Pregnant women most often experience constipation and this validates the use as a laxative by 3.4% of pregnant women in this study.

Cassava leaves (*Manihot esculenta*)

Cassava leaves are consumed as a vegetable in at least 60% of countries in sub-Saharan Africa and some Asian and Latin American countries.[99,100] The parts of the plant that are commonly utilized are the roots and leaves.[101] In almost all cassava-growing African countries, from Senegal to Mozambique, cassava leaves are consumed at varying levels as a source of protein and micronutrients, depending on the cultivar and recipes. In Central Africa, people enjoy eating cassava leaves.[100] Cassava is considered "all sufficient" in the Democratic Republic of the Congo because people get "bread" from the roots and "meat" from the leaves.[100] In the Democratic Republic of the Congo, cassava leaves have a share of more than 60% of all vegetables consumed. Also, in countries such as Zaire now Democratic Republic of Congo, Congo, Tanzania, Sierra Leone, Nigeria, and Guinea, cassava leaves constitute a major component of the diet.[102] The widespread cassava consumption in Africa explains why it is widely consumed by 39.2% of pregnant women in this survey. In addition, the plant contains several antioxidant compounds, namely α-carotene,[99] vitamin C, vitamin A, anthocyanins (flavonoids), saponins, steroids, and glycosides.[103] Since cassava leaves have a high level of antioxidants, such as flavonoids, saponins, vitamin C, and α-carotenes, the cassava plant is presumably capable of counteracting the effects of oxidants (free radicals), suggesting the possibility that the leaves affect the inflammatory process, the pathophysiology of which also involves free radicals. Yi et al., identified 10 antioxidant compounds from the plant by activity-guided isolation such as coniferaldehyde, isovanillin, 6-deoxyjacareubin, scopoletin, syringaldehyde, pinoresinol, p-coumaric acid, ficusol, balanophonin, and ethamivan. All these compounds were found to possess strong antioxidant activity.[104] The use of cassava by pregnant women for general health and vitality (46.9%) can be explained by the presence of several minerals, amino acids, antioxidants, and vitamins present in the leaves of cassava. It also contains high contents of vitamins, B_1, B_2, C, carotenoids, and minerals like phosphorous, magnesium, potassium, and calcium but low contents of manganese, zinc, iron, copper, and sodium. The level of potassium, magnesium, phosphorous, zinc, and manganese decreases while calcium, sodium, and iron increase with leaf maturity.[105] Hence cassava leaves are important for their nutritional value and most importantly to pregnant women. This study reported that 5.5% of pregnant women consume cassava leaves for its nutritional value. Again, the iron requirement during pregnancy increases, and with cassava leaves as a source of iron, red blood cell formation in mother and child is enhanced thereby preventing anaemia which can endanger their lives.[3,55] Vitamin C has also been found to enhance the absorption of non-haem iron by pregnant women.[3] This accounts for 31.7% of use amongst pregnant women as a blood tonic. Although cassava leaves are a source of valuable nutrients, it also has toxicity due to cyanogenic glucosides, and antinutritional factors such as high fibre content, tannins, polyphenols, and phytic acid which reduce nutrient bioavailability, nutrient uptake, and digestibility, eventually they may have toxic effects depending on the processing method and amount consumed.[106,107] Insufficiently processed cassava leaves may cause dizziness, headache, fatigue, nausea, diarrhoea, vomiting, stomach pains, and weakness and sometimes lead to death.[108]

Beans leaves (*Vigna unguiculata*)

Cowpea also known as Vigna unguiculata, is a widely grown legume crop in developing countries of Africa, Northern and North-eastern regions of Brazil, Latin America, and Asia due to their highly nutritive value at low cost.[109,110] Cowpea (*Vigna unguiculata*), also known as black eye pea is a legume of African origin.[111] The plant is used in measles, smallpox, adenitis, and sores. Decoction or soup is used in infections of the liver and spleen, intestinal colic, leucorrhoea, and urinary discharges.[112] *Vigna unguiculata* has become a part of the human diet in African countries because, a high amount of protein (23%), carbohydrates (56%) and fibres (4%) are found in it that can fulfil the human essential amino acid requirements when complemented with cereals.[113] The little leaves and immature pods are used as vegetables. Up to 1.7% of pregnant women reported using *Vigna unguiculata* as a vegetable in their diet. *Vigna unguiculata*

shoots and leaves contain various minerals but it is rich in potassium, calcium, magnesium and phosphorus.[114] It also contains iron, zinc, sodium, manganese, copper and selenium in small amounts.[114] *Vigna unguiculata* contains a rich amount of Vitamin A & C and also contains a good amount of vitamin B_6, thiamin, riboflavin, niacin, pantothenic and a small amount of folate.[114] The iron requirement during pregnancy increases and with cowpea leaves as a source of iron, red blood cell formation in mother and child is enhanced thereby preventing anaemia which can endanger their lives. Vitamin C has also been found to enhance the absorption of non-haem iron by pregnant women. This accounts for its 32% use amongst pregnant women as a blood tonic. Again, because of these nutrients provided by cowpeas, it becomes extremely important and valuable mainly for pregnant women whose nutrient requirements are on the rise. This research confirmed the appropriateness of pregnant women (7.3%) eating bean leaf for its nutritional benefits. The plant also contains a higher content of three flavonoid aglycons: quercetin, kaempferol, and isorhamnetin.[115] These compounds have high antioxidant activities that can promote general well-being and hence account for their usage in 47.1% of pregnant women for their ability to provide good health and vitality.

Baobab leaves (*Adansonia digitata*)

Baobab is found distributed in the hot and dried regions of tropical Africa, native to the arid parts of Central Africa, and spreads widely across the savannah regions.[116] Throughout Africa the baobab is regarded with awe by most indigenous people; some even consider it bewitched.[117] Almost all parts of the tree are used in traditional medicine in Africa although this varies from one country to another. In some countries in West Africa, the leaves, fruit pulp, and seeds are the main ingredients in sauces, porridge, and beverages.[118,119] Baobab leaves, bark, pulp, and seeds are used as food and for multiple medicinal purposes in many parts of Africa.[120] Powdered leaves are used as a tonic and an anti-asthmatic and are known to have antihistamine and anti-tension properties. Baobab leaves (Figure 8) are used medicinally as a diaphoretic, an astringent, an expectorant, and as a prophylactic against fever.[117] Leaves are used to treat kidney and bladder diseases, asthma, general fatigue, diarrhoea, inflammations, insect bites, and guinea worm.[117] Its reported use as a tonic is evident as it is consumed by 25% of pregnant women in this research. Leaves contain protein, lipids, carbohydrates, ash, vitamin C, traces of calcium, phosphorus, and mucilage. The fruit consists of protein, lipids, ash, calcium, and vitamin B_1.[121] The baobab tree has multi-purpose uses and every part of the plant is reported to have a nutritional value as a protein and minerals source. Recently, baobab has been referred to as a "superfruit" based on its nutritional profile including vitamins, fatty acids, and minerals.[122] The nutritional value of baobab is very important to pregnant women since they require extra nutrients to compensate for the foetus that they carry and hence account for the high intake of 9.5% of pregnant women in this survey. One study demonstrated that the consumption of 40 g of baobab pulp provides 100% of the recommended daily intake of vitamin C in pregnant women between the ages of 19 and 30 years.[118] The high vitamin C content offers a very high antioxidant potential for the plant. It is no surprise then that about 44.9% of pregnant women use this herb for good health and vitality coupled with its immunostimulant abilities.[123]

Bitter leaf (*Vernonia amygdalina*)

Vernonia amygdalina grows predominantly in tropical Africa, especially in Nigeria, Zimbabwe, and South Africa and it is domesticated in parts of West Africa.[124,125]. It is popularly called bitter leaves because of its bitter taste and is used as vegetables or as flavour in decoction soups. The leaves, roots, and twigs of the plant are used for treating wounds, venereal diseases, and hepatitis.[125,126] It has wide folkloric uses against diverse tropical diseases. In Southern Ghana, the young fresh leaves are used in treating diabetes, fever, constipation, high blood pressure, and as laxatives.[127] Wickens also reported its use as a laxative.[117] It is also used in the treatment of diarrhoea, dysentery, hepatitis, and cough and as a laxative and fertility inducer.[128] This agrees with its use as a laxative in this survey by 22.9% of pregnant women. In addition, extracts of the plants have been reported to be used in Nigerian herbal homes as a tonic, in the control of ticks, and for the treatment of hypertension.[129,130] Report of its use as a tonic reflected in this survey as about 24.4% of pregnant women reported consuming it as a tonic. *Vernonia amygdalina* has been established to possess antioxidant properties that correlate to its medicinal properties. [125,126] They are plants known to play dietary as well as functional roles in disease prevention. Antioxidant activities of bioactive compounds isolated from *Vernonia amygdalina* leaves have been established in various studies. Flavonoids were predominantly responsible for the antioxidant properties of *V. amygdalina*.[124] Antioxidants generally promote general well-being and hence may account for their use by pregnant women (33.6%) for good health and vitality. The leaves are consumed as green leafy vegetables. Its richness in minerals and vitamins has made it an important human diet.[131] This nutritive nature of bitter leaf makes it a good choice for pregnant women as this study revealed that 3.8% of pregnant women consumed it. Challand & Willcox reported the use of *V. amygdalina* roots and the leaves traditionally to treat fever, stomach discomfort, hiccups, and kidney problems.[132] This is evident in the use of bitter leaf by 3.8% of pregnant women in the treatment of fever. More so, it is known as a quinine substitute because it is widely used for the treatment of fevers.[132] Again, the decoction of the leaves is commonly recommended for the treatment of dysentery and other gastrointestinal tract problems that may precipitate fever.[133] Other uses include the management of diabetes, induced nausea, emesis, and loss of appetite hence its use as an appetite stimulant by 5.3% is not surprising.[134]

Moringa leaves (*Moringa oleifera*)

Moringa oleifera Lam. is a tree that grows widely in many tropical and subtropical countries. It is grown commercially in India, Africa, South and Central America, Mexico, Hawaii, and throughout Asia and Southeast Asia.[135,136] In Ghana, most people consume indigenous green leafy vegetables such as cocoyam leaves "Kontomire", Amaranthus leaves "Aleefu" and water leaf "Bokoboko" but moringa is popular in Ghana amongst them because of its medicinal characteristics.[137] It has been widely publicized and people are encouraged to use its leaves, beans, and oil for food.[137] In some areas, immature seed pods are eaten, while the leaves are widely used as a basic food because of their high nutrition content,[138] Moringa leaves have been characterized to contain a desirable nutritional balance, containing vitamins, minerals, amino acids, and fatty acids.[138] This report, however, contradicts the outcome of this survey as no pregnant woman reported using this herb for its nutritive abilities. Moringa leaves have been reported to be a rich source of beta-carotene, protein, vitamin C, calcium, and potassium and act as a good source of natural antioxidants; thus enhance the shelf-life of fat-containing foods due to the presence of various types of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids.[139-142] This agrees with the fact that 20.4% of pregnant women consumed this herb for good health and vitality. Moringa has been reported as an anti-malarial and anti-diabetic.[143] Patel et al. also stated that Moringa can be used as an effective anti-malaria due to its high content of acetone compound.[144] According to several publications, various preparations of *M. oleifera* are used for their anti-

inflammatory, antihypertensive, diuretic, antimicrobial, antioxidant, antidiabetic, antihyperlipidemic, antineoplastic, antipyretic, antiulcer, cardioprotectant, and hepatoprotectant activities.[138,145] This validates the use of moringa by 46.9% and 12.2% of pregnant women in treating fever and malaria respectively. Moringa is suggested as a viable supplement of dietary minerals. The pods and leaves of Moringa contain a high amount of Ca, Mg, K, Mn, P, Zn, Na, Cu, and Fe,[146] The high iron content of this herb promotes blood synthesis which provides the extra blood required for the foetus and mother. This explains why 4.8% of pregnant women reported consuming it in this survey. More so, in the Philippines, it is known as the 'mother's best friend' because of its utilization to increase women's milk production and is sometimes prescribed for anaemia.[147,148] Equally important is the fact that few parts of the tree contain any toxins that might decrease its potential as a source of food for animals or humans.[149]

Conclusion

Women in northern Ghana use several plant materials for the preparation of food and beverages which are intended to support the growth and development of the foetus and also enable them to manage pregnancy-related symptoms such as pain, constipation, anaemia, nausea, and vomiting, among others. Again, some of these plants were intended to help them manage some chronic conditions such as hypertension. Besides providing the mother and child with nutritional and medicinal support, some plants are also used for spiritual support during pregnancy. Pregnant women are justified in using these plants for culinary purposes since chemical and pharmacological analyses of these plants have shown they exhibit a positive effect on some pregnancy-related symptoms and also provide nutrients that support the health of the expectant mother and the unborn child. Women in Ghana should therefore be encouraged to include these plant materials in their diet, especially during pregnancy.

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Conflicts of interest

The authors declare that there are no conflict of interest.

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