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Ethnobotany of Traditional Plant Cosmetics Utilised by Women: A Study in Northern Ghana

Abstract

Research has focused on plants with medicinal value or used as food neglecting the study into those used as cosmetics. This cross-sectional study was thus conducted among women in the Tamale metropolis to specifically identify plants used as cosmetics and determine the level of usage among women. Using convenience sampling method, 383 participants were selected from 20 randomly selected communities in Tamale. A semi-structured questionnaire was used to collect the data which was then analyzed using Microsoft Excel version 2310 and IBM Statistical Package for Social Sciences (SPSS) software version 25.0. The results of the data analysis were presented in tables and graphs. Bivariate analysis was used to determine the association between some variables. Statistical significance is assumed at $p < 0.05$ at a confidence level of 95%. A total of 59.5% of women used 19 plants belonging to 18 families for cosmetic purposes. The most preferred application areas were skin, hair and private parts whereas the main cosmetic uses were skin smoothening (33.4%), skin protection (8.1%), hair growth (13.3%), treatment of acne (11.7%), body odour (9.9%) and vaginal hygiene (5.7%). All the sociodemographic characteristics except marital status found no statistically significant association with the use of plants as cosmetics ($p > 0.05$). Single women used plant cosmetics significantly more than their married counterparts ($\chi^2 = 7.870$; p-value = 0.020). Extracts from seeds of the Shea tree (*Vitellaria paradoxa*), and leaves of Aloe vera (*Aloe barbadensis*) were the most commonly used plant materials for cosmetic purposes. Continuous research is needed to record and preserve this indigenous knowledge.

Keywords: Cosmetics, herbal, females, plants

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Abbreviations: TMA, Tamale metropolitan assembly; MMDAs, Metropolitan, Municipal and District Assemblies; SPSS, Statistical Package for Social Sciences

Introduction

Plants have been used as food, medicine and spices since the dawn of humanity.[1] In traditional folk medicine, plants can also be used to treat dermatological conditions and improve a person's appearance and personality or hygiene.[2,3] According to Rogiers and Pauwels (2008), the European Commission defined cosmetics as "any substance or preparation intended to be placed in contact with different external parts of the human body (epidermis, hair, nails, and lips) or the teeth and the mucous membrane of the oral cavity with the sole or primary goal of cleaning them, smelling them, altering their appearance or odours, and protecting them in good condition".[4] Many tribes employed plant-based lotions, powders, and oils to improve their attractiveness and for therapeutic purposes.[5] Natives in Suriname on the north-east coast of South America use Aloe vera (*Aloe barbadensis)* as the main cosmetic ingredient in skin care products and anti–ageing creams. They also use neem tree (*Azadirachta indica)* to make facial and eye masks products and coconut (*Cocos nucifera)* to make soaps, hair care products and anti-acne creams.[6] Furthermore, tribal women of Kashmir Himalayas use the extracts of garlic (*Allium sativum*) to treat toothache and the cloves (*Syzygium aromaticum*) are crushed and applied on the face to treat pimples.[7] Also, in the Indian state of Chhattisgarh, inhabitants use coconut milk and carrot juice as anti–ageing cream.[8] The use of plants in cosmetics has advanced over time due to their natural properties that offer a variety of advantages for the skin and hair.[9] Women especially have always resorted to the use of herbal remedies to maintain and enhance their beauty.[10]

There is a growing interest in phytochemicals in cosmetics because of their ability to protect the skin from both external and internal harmful substances and also help in resolving many skin diseases.[11] These phytochemicals produce their cosmetic effect through their antioxidant properties, anti-inflammation activity as well as antibacterial and antifungal activities. For example, Aloe vera (*Aloe barbadensis)*, a succulent plant native to Africa, has been used for centuries for its medicinal properties and is commonly found in cosmetics due to its hydrating, soothing, and healing effects on the skin.[12] Also, chamomile (*Matricaria chamomilla*) a herb that has been used in traditional medicine for centuries, is a popular ingredient in cosmetics due to its anti-inflammatory and calming properties.[13] Additionally, green tea, a popular beverage derived from the *Camellia sinensis* plant, has been shown to possess antioxidant and anti-ageing properties, making it a valuable ingredient in cosmetic formulations.[14]

Research into the properties and potential benefits of plants used for cosmetic purposes has increased in recent years, as consumers have become more interested in natural and sustainable beauty products with less or no side effects to the skin, as well as the recognition of the potential health benefits of these plant-based cosmetics.[9] The cosmeceutical sector is currently expanding due to the addition of natural components to many cosmetic products and the increasing awareness of the harmful effects of synthetic chemicals on their skin and the environment.[5]

But the tragic reality of our time is that valuable cosmetic ethnobotanical information are being lost. The younger generation prefers allopathic treatments and cosmetics due to a lack of enthusiasm and expertise or knowledge.[15] This study therefore investigated plants that are used as cosmetics among the women in the Tamale metropolis and documented this indigenous knowledge to prevent them from being lost.

Methods

Study design

A cross-sectional study design was applied in this research between January and December 2023.

Study location

The study was conducted at the Tamale Metropolitan Assembly (TMA) area. It is among the 16 Metropolitan, Municipal, and District Assemblies (MMDAs) in the Northern Region. In 2004, the Tamale Metropolitan Assembly was given the metropolis status with its capital as Tamale which is located between longitudes 0.36° and 0.57° west and latitudes 9.16° and 9.34° north. The metropolis is bordered to the north by Sagnerigu District, to the east by Yendi Municipal Assembly, to the west by Tolon District, to the south-west by Central Gonja District, and to the south by East Gonja municipality. The metropolis has a 440.4 km^2 total land area and an 850.8 persons/km^2 population density according to Ghana Statistical Service as indicated by Brinkhoff[16].

Study population

The study was conducted among female residents in Tamale who were 18 years or above. Females who are above 18 years are legally considered adults so they can provide informed consent and are at the age where they pay attention to their appearances.

Study site

Twenty (20) communities out of the 116 in Tamale were selected randomly using the "RAND" function in Microsoft Excel version 2310 for the study. The randomly selected suburbs include; Lamashegu, Wamale, Gumbihini, Vittin, Chagnayili, Dohini, Pagazaa, Ticheli, Lahagu, Bogkurugu, Kumbuyili, Sugashee, Choggu-Manayili, Batanyili, Gbanyamli, Gunnaayili, Doboagshie, Yong, Checko, Sanga.

Sample size

The total population of females in Tamale in 2010 was 185,356 of which the population of females 18+ years was 106,540 (57.5%).[6] According to the 2021 Population and Housing Census by the Ghana Statistical Service, the total number of females is 189,693.[16] The 2021 census has no published data on the distribution of females according to their age. Therefore, assuming the percentage of females 18+ years is 57.5% then the population of females 18+ years is 109,053. Hence our study population was 109,053. The sample size was calculated using Cochran's standard formula (1977) at a confidence interval of 95%,

$$n_0 = \frac{z^2 pq}{e^2}$$

Where: n_0 = the sample size, z = the abscissa of the normal curve that cuts off an area at the tails (set at 1.96 which corresponds to the 95% confidence interval), p = the estimated proportion of an attribute that is present in the population, set at 0.5, q = 1-p, e = acceptable sample error = 0.05

$$n_0 = \frac{1.96^2 x 0.5 x 0.5}{0.05^2}$$

$$n_0 = 384$$

Using the Finite Population Correction formula which is:

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}}$$

Where: n = desired sample size, N = sample population size (females 18+ years) = 109,053

$$n = \frac{384}{1 + \frac{384 - 1}{109,053}}$$

$$n = 383$$

The sample size for this study was therefore 383

Sampling Technique

Convenience sampling was used in selecting the participants from the 20 communities in Tamale for the study. In entering a suburb, the researchers move along the busy streets and speak with any female who says she is over 18 years old and willing to partake in the study. This continued until the minimum number (19) for each suburb was reached.

Study Tools

The semi-structured questionnaire was designed de novo based on the literature on cosmetics. The questionnaire was piloted among 20 females in Dungu, one of the suburbs in Tamale. The responses were reviewed by senior faculty at the Department of Pharmacognosy and Herbal Medicine of the University for Development Studies, Tamale, to ensure face validity. The questionnaire was of two parts. Part A sought information on the socio-demographic characteristics of the participants such as age, sex, residence, level of education, occupation and marital status. The second part (Part B) of the questionnaire obtained information on various cosmetic conditions that plants have been used to treat. They included the traditional name(s) of the plant and the plant part(s), cosmetic uses of the plants, mode of preparation and mode of administration of plant species.

Data Collection Techniques

Whereas a few respondents self-administered the questionnaire, for the majority, the questions were translated mainly to the local language, Dagbanli or Twi, a widely spoken Ghanaian language and the responses were recorded on the hard copy of the questionnaire.

Statistical Analysis

The data was analysed using Microsoft Excel version 2310 and IBM Statistical Package for Social Sciences (SPSS) Version 25. The results of the data analysis were presented in tables and charts. Also, the appropriate inferential statistical tool was used to determine the association between variables. Statistical significance and confidence level were assumed at $p < 0.05$ and 95% respectively.

Results

Sociodemographic Characteristics of Respondents

Table 1 shows the sociodemographic characteristics of respondents. Most, 159 (41.5%) of the respondents were between the ages of 21 and 30 years with the least of them, 10 (2.6%) being more than 60 years. Majority, 240 (62.7%) were in informal employment while 67 (17.5%) were students, with 55 (14.3%) and 21 (5.5%) being unemployed and those in formal employment respectively. Whilst, 10 (2.6%) grew up in district capitals, the majority, 198 (51.7%) grew up in cities. About their marital status, 217 (56.7%) were married, while 157 (41.0%) were single. Whereas, greater proportion, 140 (36.6%) of the female respondents had obtained senior high school level education, only 19 (5.0%) had completed a tertiary level educational institution. Majority,

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253 (66.1%) were living in single-room apartments, while the least 9 (2.3%) lived in at least a 4-bedroom apartment.

Table 1 Socio-demographic characteristics of respondents

Variables	Subgroup	Frequency	Percentage
Age (years)	< 21	80	20.9
	21 - 30	159	41.5
	31 – 40	77	20.1
	41 – 50	40	10.5
	51 – 60	17	4.4
	> 60	10	2.6
Employment status	Informal	240	62.7
	Student	67	17.5
	Unemployed	55	14.3
	Formal	21	5.5
Location of early life	Village	152	39.7
	District capital	10	2.6
	Regional capital/Town	23	6.0
	Cities	198	51.7
Marital status	Married	217	56.7
	Single	157	41.0
	Widowed	9	2.3
Highest level of education	No formal education	117	30.5
	JHS	107	27.9
	SHS	140	36.6
	Tertiary	19	5.0
Type of accommodation	Single room	253	66.1
	Chamber and Hall	73	19.1
	2 -3-bedroom apartment	48	12.5
	At least 4 bedrooms	9	2.3

Purposes for which the respondents use plants as cosmetics

Table 2 shows the reports on women who use or have ever used plants for any cosmetic purpose. This study shows the top six most common uses of plants by the respondents for cosmetic purposes were for the toning and smoothening of the skin (128, 33.4%), hair growth and improvement (51, 13.3%), treating acne/pimples (45, 11.7%), body odour (38, 9.9%), skin protection (31, 8.1%) and the vaginal hygiene (22, 5.7%). The study found no use of plant materials for treating wrinkles, make-up, toothache, hair colouring and as perfume.

Table 2 Purposes for which respondents use plants as cosmetics

Variables	Response	Frequency	Percentage
Ever used it for skin protection?	Yes	31	8.1
	No	352	91.9
Ever used it for skin fairness?	Yes	1	0.3
	No	382	99.7
Ever used it for toning and smoothening skin?	Yes	128	33.4
	No	255	66.6
Ever used it for acne?	Yes	45	11.7
	No	338	88.3
Ever used it for dry skin care?	Yes	15	3.9
	No	368	96.1
Ever used it for exfoliation?	Yes	6	1.6
	No	377	98.4
Ever used it for wrinkles?	Yes	0	0.0
	No	383	100.0
Ever used it for dark spots?	Yes	7	1.8
	No	376	98.2
Ever used it for stretch marks?	Yes	2	0.5
	No	381	99.5
Ever used it for body cleaning?	Yes	2	0.5
	No	381	99.5
Ever used it for body odour?	Yes	38	9.9
	No	345	90.1
Ever used it for make-up?	Yes	0	0.0
	No	383	100.0
Ever used it for eye care?	Yes	1	0.3
	No	382	99.7
Ever used it for dark circles?	Yes	3	0.8
	No	380	99.2
Ever used it for anti-ageing?	Yes	1	0.3
	No	382	99.7
Ever used it for mouth odour?	Yes	4	1.0
	No	379	99.0
Ever used it for a toothache?	Yes	0	0.0
	No	383	100.0
Ever used it for nail care?	Yes	10	2.6
	No	373	97.4
Ever used it for smelly feet?	Yes	4	1.0
	No	379	99.0
Ever used it for vaginal hygiene?	Yes	22	5.7
	No	361	94.3
Ever used it for hair growth?	Yes	51	13.3
	No	332	86.7
Ever used it as hair perfume?	Yes	0	0.0
	No	383	100.0
Ever used it for hair loss?	Yes	2	0.5
	No	381	99.5
Ever used it for dandruff?	Yes	2	0.5
	No	381	99.5
Ever used it for hair colouring?	Yes	0	0.0
	No	383	100.0

Plants Used for Cosmetics Purposes

A total of 19 plants belonging to 18 different families were listed by the respondents as being used as cosmetics (Table 3). The top ten plants listed were; shea tree (*Vitellaria paradoxa),* 170 (44.4%); Aloe vera (*Aloe barbadensis)* 40 (10.4%); lime (*Citrus aurantifolia*), 38 (9.9%); cloves (*Syzygium aromaticum*), 20 (5.2%); turmeric (*Curcuma domestica*), 18 (4.7%); henna (*Lawsonia inermis*), 11 (2.9%); neem (*Azadirachta indica*), 5 (1.3%); coconut (*Cocos nucifera*), 3 (0.8%) moringa (*Moringa oleifera*), 2 (0.5%) and Cucumber (*Cucumis sativus*), 2 (0.5%).

Methods of Preparation and Application of Plant Cosmeceuticals

Table 4 shows the raw plant materials with their cosmetic uses, parts of the plant used, method of preparation and body parts to which respondents apply them. Shea butter from the seeds of *Vitellaria paradoxa* was used mainly for smoothening the skin and moisturizing dry skin and hair. Lime was used to treat body odour as well as smelly

feet. The powdered rhizome of turmeric was used to treat acne, dark spots and for exfoliation. The leaves of Aloe vera performed a similar function as turmeric on the skin but were also used alone or together with the stem or branches of the neem tree to remove mouth odour. To improve hair texture and hair growth, respondents resorted to using shea butter and Aloe vera. Rice and moringa were also used to treat dandruff and hair loss respectively. Cloves were soaked overnight, filtered and the filtrate was splashed around the vagina to clear off bad odour. Henna was occasionally used to beautify the hands and feet and rarely to treat acne.

Table 3 Plants used for cosmetics purposes

Common /local name	Scientific name	Family	Parts used	Number of users	Percentage
Shea tree(tááŋà)	*Vitellaria paradoxa*	Sapotaceae	Seed	170	44.4
Aloe vera	*Aloe barbadensis*	Asphodelaceae	Leaves	40	10.4
Lime(nyòmsá)	*Citrus aurantifolia*	Rutaceae	Fruit	38	9.9
Cloves	*Syzygium aromaticum*	Myrtaceae	Flower buds	20	5.2
Turmeric (àsóómà)	*Curcuma domestica*	Zingiberaceae	Rhizome	18	4.7
Henna (zàblìgá)	*Lawsonia inermis*	Lythraceae	Leaves	11	2.9
Neem (nyímsà)	*Azadirachta indica*	Meliaceae	Leaves Stem Branches Seeds	5	1.3
Coconut	*Cocos nucifera*	Arecaceae	Kernel	3	0.8
Moringa (jèŋgbè yògrlí)	*Moringa oleifera*	Moringaceae	Leaves	2	0.5
Cucumber	*Cucumis sativus*	Cucurbitaceae	Fruit	2	0.5
Cocoa	*Theobroma cacao*	Malvaceae	Fruit	1	0.3
Tomato	*Solanum lycopersicum*	Solanaceae	Fruit	1	0.3
Mango	*Mangifera indica*	Anacardiaceae	Leaves	1	0.3
Olive oil	*Olea europaea*	Oleaceae	Fruit	1	0.3
Cassava	*Manihot esculenta*	Euphorbiaceae	Stem	1	0.3
Locust beans (dawadawa, dòó)	*Parkia biglobosa*	Fabaceae	Stem	1	0.3
Carrot	*Daucus carota*	*Apiaceae*	Root	1	0.3
Okro	*Abelmoschus esculentus*	Malvaceae	Fruit	1	0.3
Rice	*Oryza sativa*	Poaceae	Seed	1	0.3

Table 4 Plant materials used by females for cosmetic purposes

Common/ (local name)	Scientific name	Part(s) used	Cosmetic use	Method of preparation	Place of administration
Cloves	*Syzygium aromaticum*	Flower buds	Vaginal hygiene, hair loss	Soak in water, filter and use the filtrate	Vagina and hair
Lime (nyòmsá)	*Citrus aurantifolia*	Fruit	Body odour, smelly feet	Squeeze the juice out	Axilla, feet
Aloe vera	*Aloe barbadensis*	Leaves	Acne/pimple, hair conditioner, exfoliation, skin protection, dark spots, mouth odour	Peel and scoop gel	Face, hair and body
Shea butter (tááŋà)	*Vitellaria paradoxa*	Seed	Skin smoothness and toning, dry skin care, skin protection, hair growth and improvement	After the kernel is removed from the seed, it is ground into a powder and boiled in water. The butter then rises to the top of the water and becomes solid	Body and hair
Turmeric (àsóómà)	*Curcuma domestica*	Rhizome	Exfoliation, acne/ pimple, dark spots, skin fairness	Make a paste from turmeric powder and water	Face
Henna (zàblìgá)	*Lawsonia inermis*	Leaves	Beautifying hands and feet, treating acne	Make a paste from henna powder and water	Feet, hands and face
Cucumber	*Cucumis sativus*	Fruit	Dark circles	Slice the cucumber into smaller pieces	Face
Neem (nyímsà)	*Azadirachta indica*	Leaves, stem, branches and seeds	Chewing sticks for mouth freshener, acne, skin smoothening, mosquito repellant	Peel off the bark, wash and break into desirable sizes. Brush teeth with the sticks	Various parts of the body

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Table 4 Continued...

Coconut	*Cocos nucifera*	Kernel	Skin smoothening	Add oil extract to any desirable pomade	Body
Moringa (jèŋgbè yògrlí)	*Moringa oleifera*	Leaves	Hair loss, skin rashes, treating pimples	Dry leaves, blend and make a paste	Hair and Body
Olive oil	*Olea europaea*	Fruit	Dandruff	Oil extracts from fruit	Hair
Mango	*Mangifera indica*	Leaves	Stretch marks	Crush leaves and make a paste of leaves with water	Body
Cassava	*Manihot esculenta*	Stem	Soap	Add water to the burnt ashes of the stem and add to shea oil	Body
Locust beans (dawadawa, dòó)	*Parkia biglobosa*	Stem	Soap	Add water to the burnt ashes of the stem and add to shea oil	Body
Rice	*Oryza sativa*	Seed	Dandruff	Soak in water, filter and use the filtrate	Hair
Tomato	*Solanum lycopersicum*	Fruit	Acne	Slice into two and apply directly on the face	Face
Cocoa	*Theobroma cacao*	Fruit	Soap	Burn the dry fruit and use the ash	Body
Okro	*Abelmoschus esculentus*	Fruit	Smelly feet	Blend okro	Feet
Carrot	*Daucus carot*a	Root	Anti – ageing	Grind carrot, add desirable oil (vegetable or coconut oil) and place on low heat for about 5 minutes. Allow to cool, filter and use the filtrate	Body

Level of Patronage of Plant Materials as Cosmetic

The use of plants for cosmeceutical purposes was reported by majority, 228 (59.5%) of the females in this study (Table 5). Highest proportion of the respondents, 105 (46.1%) had used the raw plant materials as cosmetics for less than five years with the least proportion of respondents using these plant materials for between 11 and 15 years, 8 (3.5%). Out of the 228 respondents who have used plants as a cosmetics, only 4 (1.8%) reported experiencing a side effect they attributed to the plant material used. Only, 11(4.8%) ever used a manufactured herbal cosmetic product while a greater number of 103 (45.2%) ever used cosmetics made from synthetic chemicals. Majority, 227 (99.6%) would recommend the use of raw plant materials as cosmetics to other people.

Table 5 Level of patronage of plant materials as cosmetic

Variable	Subgroups	Frequency	Percentage
Ever used plants for any cosmeceutical purpose?	No	155	40.5
	Yes	228	59.5
How long have you used raw plant materials as cosmetics?	< 5 years	105	46.1
	5 - 10 years	63	27.6
	11 - 15 years	8	3.5
	15 -20 years	22	9.6
	> 20 years	30	13.2
Have you experienced any side effects (s)?	Yes	4	1.8
	No	224	98.2
Have you used herbal-based manufactured cosmetic products before?	Yes	11	4.8
	No	217	95.2
Have you used a synthetic cosmetic product before?	Yes	103	45.2
	No	125	54.8
Would you recommend using raw plants as cosmetics to others?	Yes	227	99.6
	No	1	0.4

Reasons for Patronising Natural Plants as Cosmetics Instead of Synthetic Cosmetic

Various reasons were given by the respondents for their use of raw plant materials as cosmetics instead of synthetic or manufactured cosmetics (Figure 1). Whereas the majority, 192 (84.6%) preferred the raw plants because they are more effective, 29 (12.8%) used them because it is less costly. It is free from chemicals (3, 1.3%) and readily accessible (3, 1.3%) are the least of the reasons respondents patronised raw plants as cosmetics.

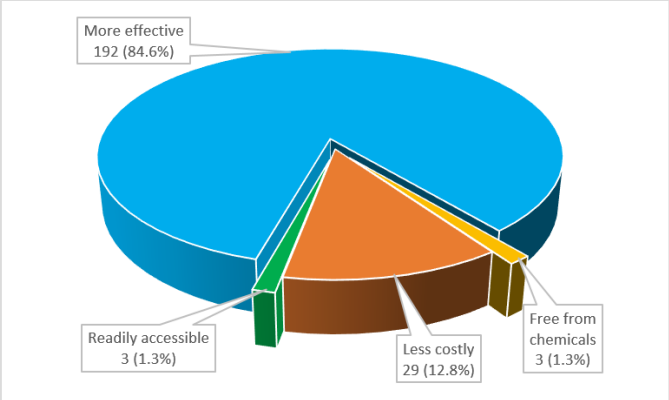

Figure 1 Reasons for patronizing natural plants for cosmetic purposes.

Sources of First-time Information on the Use of Plants as Cosmetics

The respondents listed several sources of first-time information about the use of plants as cosmetics (Figure 2). Majority indicated members of their family, 174 (76.3%) as their most important source followed by their friends, 35 (15.4%) and media, 14 (6.1%). A few of the respondents, 5 (2.2%) started using plants as cosmetics after their own personal research.

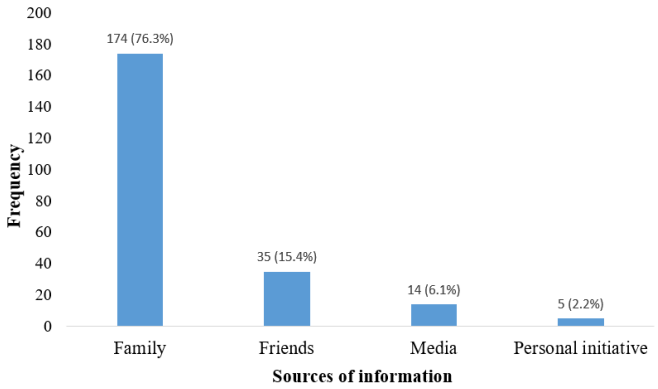

Figure 2 Sources of first-time information on the use of plants as cosmetic.

Parts of the Plants Most Used for Cosmetics

Seeds, 217 (57.0%) were the most used part of plants in preparation of cosmetic recipes from raw plant materials. This was followed by leaves, 70 (18.4%), fruits, 46 (12.1%), flower buds, 21 (5.5%), rhizome, 20 (5.2%), stem 3 (0.8%), branches, 3 (0.8%) and lastly the roots. 1 (0.2%). Figure 3 shows the parts of the plant that are used as cosmeceuticals.

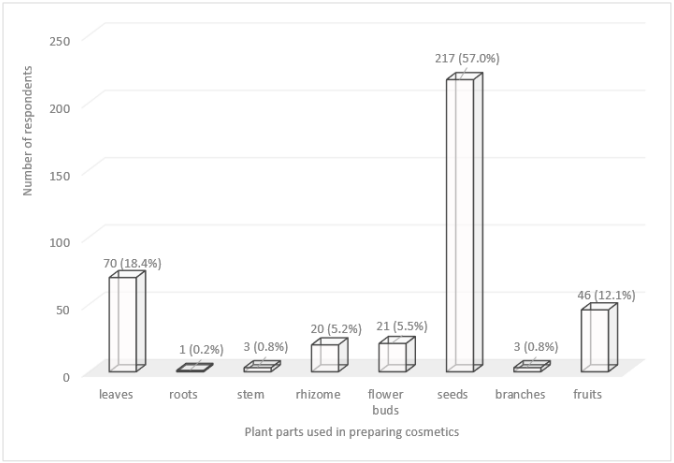

Figure 3 Parts of plants used for cosmetic preparation.

Association Between Sociodemographic Characteristics of Respondents and the Usage of Plants as Cosmetics

Table 6 shows the association between the sociodemographic characteristics of respondents and the usage of plants as cosmetics. A greater proportion of women between the ages of 21 to 30 years (42.8%) had used plants as cosmetics whereas those who were above 60 years, (10.0%) were the least age group but there was no significant difference (χ^2 = 8.267; p-value = 0.142). Self–employed women, (37.5%) were seen to patronise a lot more raw plants as cosmetics followed by unemployed women, 28 (50.9%) and then students, 28 (41.8%) and lastly formal workers, 9 (42.9%) but there was no significant difference in their level of usage (χ^2 = 3.465; p-value = 0.325). More women who grew up in the villages (69, 45.4%) patronized natural plants used for cosmetic purposes with those who lived in cities, 73 (36.9%) least likely to use plants as cosmetics, but there was no significant difference in their usage (χ^2 =2.614; p-value = 0.455). The highest use of plants as cosmetics was recorded among single women (45.2%) with (38.7%) and (0.0%), recorded among married and widowed women respectively. There was a statistically significant difference between women use of plant-based cosmetics based on their marital status (χ^2 =7.870; p-value = 0.020). There was no significant association between the use of plants as cosmetics and other sociodemographic characteristics such as level of education (χ^2 = 1.385; p-value = 0.709), type of accommodation one resides in, (χ^2 = 0.482; p-value = 0.923) and highest educational attainment by the women (χ^2 = 1.385; p-value = 0.709).

Table 6 Association between sociodemographic characteristics of respondents and the usage of plants as cosmetics

Variables	Subgroup	Ever used plants as cosmetics		p-value	Chi-square value
		Yes	No		
Age (years)	< 21	38 (47.5%)	42 (52.5%)	0.142	8.267
	21 - 30	68 (42.8%)	91 (57.2%)		
	31 – 40	29 (37.7%)	48 (62.3%)		
	41 – 50	15 (37.5%)	25 (62.5%)		
	51 – 60	4 (23.5%)	13 (76.5%)		
	> 60	1 (10.0%)	9 (90.0%)		
Employment status	Informal	90 (37.5%)	150 (62.5%)	0.325	3.465
	Student	28 (41.8%)	39 (58.2%)		
	Unemployed	28 (50.9%)	27 (49.1%)		
	Formal	9 (42.9%)	12 (57.1%)		

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Table 6 Continued...

Location of early life	Village	69 (45.4%)	83 (54.6%)	0.455	2.614
	District capital	4 (40.0%)	6 (60.0%)		
	Regional capital/Town	9 (39.1%)	14 (60.9%)		
	Cities	73 (36.9%)	125 (63.1%)		
Marital status	Married	84 (38.7%)	133(61.3%)	0.020*	7.870
	Single	71 (45.2%)	86 (54.8%)		
	Widowed	0 (0.0%)	9 (100.0%)		
Highest level of education	No formal education	44 (37.6%)	73 (62.4%)	0.709	1.385
	Basic level	47 (43.9%)	60 (56.1%)		
	Senior High School	55 (39.3%)	85 (60.7%)		
	Tertiary	9 (47.4%)	10 (52.6%)		
Type of accommodation	Single room	105 (41.5%)	148 (58.5%)	0.923	0.482
	Chamber and Hall	28 (38.4%)	45 (61.6%)		
	2 -3-bedroom apartment	18 (37.5%)	30 (62.5%)		
	At least 4 bedrooms	4 (44.4%)	5 (55.6%)		

* Statistically significant

Discussion

Whereas it is explicit when a plant is being used as food, some challenges may arise in differentiating between plant materials being used for cosmetic purposes or used to treat minor ailments. However, in this study, the plant is considered to provide a cosmeceutical role when its intended use is to enhance the physical appearance of the user, protect that external part of the body or provide good hygiene by way of cleaning, altering their appearance or odour.

Cosmeceutical Uses of Plant Materials by Women

It was seen in Table 2, more women used plants to tone and smoothen their skin. Others preferred to use it for hair growth, treating acne/pimples, body odour, skin protection and vaginal hygiene. Similar results were observed in a study by Mwinga et al.,[17] Xhosa women used plants for the above cosmetic purposes. The study also did not find the use of plants for treating wrinkles and toothache or for make-up, hair colouring and perfume. However, Sultan et al., (2024) report the use of several plants for purposes such as perfumery, and teeth hygiene, among others which were not indicated in this study.[18] The Madda Walabu district, in Southeastern Ethiopia where Sultan et al.,[18] conducted their study has a bimodal rainfall pattern unlike Tamale, which has only a season of rainfall which will influence the difference in the vegetation cover in these two study sites.[18] In this study, the major cosmetic uses of the plants were for skin care, hair care, and vaginal hygiene. For skin care, products from the shea tree (*Vitellaria paradoxa)* and coconut (*Cocos nucifera*) were used for moisturizing dry skin and smoothening skin. Shea butter contains fatty acids and vitamins, providing deep hydration and promoting skin elasticity.[19,20] Coconut oil has moisturizing and antimicrobial properties, helping to soothe and soften the skin.[21,22] Together, they can create a barrier that locks in moisture, reducing dryness and contributing to smoother, healthier-looking skin. Aloe vera (*Aloe barbadensis)* and turmeric (*Curcuma domestica*) were used for acne and dark blemishes on the face. They possess anti-inflammatory, antioxidant and antibacterial properties that can help reduce redness and inflammation associated with acne[23,24] Carrot (*Daucus carota)* was used as an anti–ageing agent because it is high in beta-carotene, a powerful antioxidant that the body converts into vitamin A.[25] Vitamin A is essential for maintaining skin health, promoting cell regeneration, and protection. Several other authors found the use of these plants for similar purposes as shown in this study.[9,26,27] The use of Lime *(Citrus aurantifolia)* by the women in this study for skin hygiene can be explained by the proven activity of the extract of this plant which is known to possess natural antibacterial and antimicrobial properties, thereby combating odour-causing bacteria on the skin.[28] The acidity of lime may also assist in neutralizing or masking unpleasant odours. For hair care, women used cloves (*Syzygium aromaticum*) which is rich in antioxidants, to help combat oxidative stress linked to hair loss, and antioxidants may protect hair follicles from damage to prevent hair loss.[29,30] This study found the use of rice (*Oryza sativa)* to treat dandruff, Aloe vera (*Aloe barbadensis)* and shea butter (*Vitellaria paradoxa)* for hair growth. Enechukwu and Ogunbiyi[31], also reported the use of several indigenous plants for hair and scalp disorders in Nigeria.[31] The antimicrobial properties of essential oil from the flower buds of cloves as reported by Maggini et al.,[32] may account for its use for the improvement of vaginal hygiene by women in this study.[32] The stem and branches of the neem tree (*Azadirachta indica)* were used as a chewing stick to clean the teeth and remove mouth odour just as reported by Sultan et al.,[18].

Plants Used as Cosmetics

A total of 19 plants belonging to 18 different families were discovered to be used as cosmetics. In a study conducted in Oyo, Ogun, Ekiti, and Lagos states in Nigeria by Fred-Jaiyesimi et al.,[33], 80 species belonging to 39 families were discovered.[33] The high rainforest zone of these states could suggest the high number of plants identified. The most represented family was Malvaceae with two species. The rest of the families had one species each. The most used family was Sapotaceae to which the shea tree (*Vitellaria paradoxa)* belongs. This is because the shea tree grows mostly in the savannah ecological zone making it more common in Northern Ghana where the study site, Tamale is located. Aside from the shea tree (*Vitellaria paradoxa),* Aloe vera (*Aloe barbadensis)*, lime (*Citrus aurantifolia*), cloves (*Syzygium aromaticum*), turmeric (*Curcuma domestica*), henna (*Lawsonia inermis*), neem (*Azadirachta indica*), coconut (*Cocos nucifera*), moringa (*Moringa oleifera*) and cucumber (*Cucumis sativus*) were among plants with high-value use. Shea tree (*Vitellaria paradoxa)*, lime (*Citrus aurantifolia*), cloves (*Syzygium aromaticum*), henna (*Lawsonia inermis*), and neem (*Azadirachta indica*) were also reported among plants that were commonly used by Arab-Choa and Kotoko Ethnic Groups in the Semi-Arid Areas of Far North Cameroon.[27]

Sociodemographic Factors Associated With the Use of Plant Cosmeceuticals

Among the sociodemographic characteristics, it was observed that more women between 21 and 30 years used plants as cosmetics than those more

than 50 years, but there was no significant difference based on the age of the respondents. This present finding is consistent with a study by Abdalbasit et al.,[34] where elderly women, above 50 years (11.9%) were less endowed in indigenous knowledge of herbal cosmetics than the younger women, below 30 years (38.1%).[34] Compared to a study by Shaheen et al.,[35] where the elder generation (>30 years) were knowledgeable, this study reflects the traditional usage of plants for cosmetic purposes being established and high in the younger generation (< 30 years).[35] Between employment status, location of early stage of life, and education, there was no significant association of these demographic characteristics with the use of plants as cosmetics. This indicates that employment status, location of early stage of life and level of education did not influence the use of plants as cosmetics by women. There was also no significant difference between the types of accommodation with the use of plants. The type of accommodation was used to determine the economic status of the respondents. Hence the income of women did not influence the use of plants as cosmetics. These results were similar to the outcome of the study by Abdalbasit et al.,[34], in which age group, occupation and education level had no influence on the usage of plants as cosmetics but marital status did.[34] In this study, marital status was significantly associated with the use of plant cosmetics (χ^2=7.870; p-value = 0.020). It is expected that married women would utilise plants as cosmetics more frequently to keep their bodies whole and preserve their attractiveness for their spouses but the contrary was found in this study with single women patronising plant-based cosmetics a lot more. Cosmetic is a common tool used by single women who wish to stand out and appeal to men to project confidence, sociability, and assertiveness. Others who suffer from anxiety and insecurity may conceal their imperfections with cosmetics.[36]

Plant Parts of Cosmeceutical Importance to Respondents

The survey revealed that different morphological parts of plants were used in the preparation of recipes for cosmetic purposes. These parts included the seeds, leaves, fruits, flower buds, rhizome, branches, stem and roots. Among the plant parts used, seeds and leaves were most utilised with roots being least as seen in Figure 3. This study corroborates the study by Haque and Uddin[37] which also found seeds (25%) and leaves (28%) as the most used plant parts.[37] Other studies showed leaves as the most used plant parts for cosmetic preparation.[3,38] The high-level use of seeds and leaves shows that the use of plants for cosmetic purposes in Tamale does not pose a threat to the survival of these plants since the leaves and seeds are in abundance, unlike the root on which the plant depends for its physiological survival. The predilection for leaves stemmed from their ease of availability, ease of harvesting, and ease of preparation for remedies.[39] Leaves are frequently utilised because they serve as both a source for photochemical reactions and a storage site for organic matter resulting from these reactions. They contribute significantly to the presence of alkaloids, glycosides, and essential oils.[40] Unlike this study, the bark was the most used part of plants used for cosmetic purposes among Xhosa women in South Africa.[17]

Reasons for Preferring Herbal Cosmetics Over Synthetic Ones

Various reasons were given by the women in this study for depending on plants as their cosmetics. Just as reported by Gamage et al.,[41] in Sri Lanka, the reasons among others include the plants being more effective, less costly, readily available and free from chemicals that may cause damage as compared to the manufactured cosmetics made from synthetic substances.[41]

Sources of First Knowledge About Plant Cosmetics

Most of the respondents indicated several sources of knowledge of the use of plant cosmetics with the majority of the recommenders being family members (76.3%) although a few of the respondents (2.2%) started using plants as cosmetics after their research. Jost et al.,[42] confirmed family members as being the most important source of indigenous knowledge on the use of plants for cosmetics purposes.[42] Additional ways that indigenous knowledge is shared include through elder storytelling, ceremonies, rituals, apprenticeships, and involvement in communal events.[43]

Conclusion

Shea butter from Shea tree seeds was the most commonly used plant extract for cosmetic purposes out of the 19 different plants which were identified. This is suggestive of the importance of this plant as women used it for different reasons such as skin protection, dry skin, smoothening skin and hair growth. Age group, occupation, origin of growth, level of education and type of accommodation had no association with the usage of plants as cosmetics. However, marital status was associated with the use of plants for cosmetics. Majority of respondents preferred raw plants for cosmetic purposes because they have proven to be more effective.

Declarations

Ethical consideration and consent to participate

Participants' verbal consent was given. The Student Project and Ethics Committee of the School for Pharmacy and Pharmaceutical Sciences, University for Development Studies, Tamale, Ghana approved the conduct of this study. Respondents were also provided assurances regarding the anonymity and confidentiality of the data obtained after being carefully briefed on the study. Participants weren't required to give their names when responding to the questionnaire. Additionally, it was clarified that participation was voluntary.

Consent for publication

Not applicable.

Authors' contributions

E.P.K.A. conceived the idea, designed the questionnaire, analysed the data and drafted the manuscript. J.A. designed the questionnaire, and collected, curated and analysed the data. E.A. drafted the manuscript. All authors reviewed the manuscript.

Data availability

The results presented are adequate to support the conclusion of this study. However, the lead author is available to provide extra data upon request.

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Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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