International Journal of Herbal Medicine
Available online at www.florajournal.com

E-ISSN: 2321-2187
P-ISSN: 2394-0514
www.florajournal.com
IJHM 2022; 10(2): 47-55
Received: 25-01-2022
Accepted: 12-03-2022

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Assessment of the preventive measures adopted by Nigerians during COVID-19 pandemic using herbal medicines: A questionnaire-based study

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Abstract
Four-fifth of people rely on phyto medicines to meet their healthcare needs. This study was undertaken to investigate the use of phyto medicines in preventing COVID-19. A total of 453 respondents participated in the survey via a well-structured questionnaire. Participants were mostly in the age group of 15-29 (38%) and 30-44 years (32%). Most (52%) residing in North-Central Nigeria, with 54% married, 43% singles, 55% have tertiary education and 38% are postgraduates. Thirty-five percent of them used herbs to prevent COVID-19, including ginger (38%), garlic (13%), and lemon (14%). Most respondents (73%) combined different plant parts, taken in form of teas (54%), liquid mixtures (19%), spices (5%), steam inhalation (7%), syrups (3%), and unprocessed (7%), while 38% engaged in self-medication, and 87% endorsed the development of herbal medicines to prevent COVID-19. This gives an insight into the formulation development of phytomedicine-based therapy for future consideration in the fight against the virus.

Keywords: Herbal medicine, herbs, phyto medicines, infectious disease, COVID-19, WHO

1. Introduction
Infectious diseases are the main cause of deaths and ill health, accounting for almost one-fifth of the disease burden worldwide [1]. According to WHO, (2020) [2], coronavirus disease, also known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), or novel coronavirus disease (COVID-19) is an infectious disease and a global public health crisis [3, 4]. The dreaded disease started as an epidemic in Wuhan, China, and has now become a pandemic, declared by the WHO on March 11th, 2020, and has affected every part of the globe [3, 5, 6]. Nigeria is not left out as it recorded its first case on the 27th of February, 2020, with confirmed cases rising to 255,296 and 3,142 deaths as at the time of this report. COVID-19 has caused extremely high morbidity (over 480 million) with substantial fatalities (over 6 million) worldwide, with unprecedented disruptions to human life, and an unimaginable wreckage of world economies. Although COVID-19 vaccines are now available, several of them undergoing clinical assessments, and a few been approved for emergency use [7], yet, they are not without mild and moderate to severe side effects [8, 9, 10, 11].
Phytomedicines are plant-derived medicines used for the treatment of diseases. According to the WHO, more than 80% of the people rely on phyto medicines to meet their health care needs. Although modern medicine exists, traditional herbal treatments have gained popularity for their historical and cultural values. Besides, it is believed that they are safer and have less side effects compared to modern medicines. Modern research has also pointed out that many orthodox medicines suppress the symptoms of diseases, unlike phyto medicines which demonstrate better results as they address the root cause of the disease more effectively with little side effects. Traditionally, these phyto medicines have been administered in form of pills, decoctions, infusions, tinctures, syrups and powders [12].
Nigeria, Africa's most populous country with many densely populated cities, presents a unique situation for the explosive spread of SARS-CoV-2. However, at the point of this report, the number of confirmed infection and mortality is comparatively lower than those of other countries with dense urban populations. The exact reasons for this is not clear but include societal, political and infrastructural factors that has impacted the progression of the disease in Nigeria [13]. Another possible reason could be the acclaimed use of herbal medicines as postulated by several studies [14, 15, 16, 17, 18]. This study therefore seeks to investigate the preventive measures adopted by Nigerians with respect to the use of herbal medicines in preventing the novel corona virus disease.

2. Materials and methods

2.1 Data Collection

This study was conducted within eight (8) weeks, using a well-structured online questionnaire. The snowball sampling technique was used to obtain data from respondent through social media platforms throughout Nigeria. Participation in the survey was completely consensual and voluntary. Socio-demographic data such as gender, age, marital status, educational qualification, and use of herbal medicines in COVID-19 were collected.

2.2 Statistical Analysis

The statistical analysis for social sciences (IBM SPSS version 27) was used for descriptive analysis and then computed using Microsoft excel spreadsheet. The percentage responses were calculated and the results presented below.

3. Results and Discussion

3.1 Demographic information of respondents

A total number of 453 respondents participated in the survey, 237 (52%) reside in North Central Nigeria, out of which 162 (36%) are residents of the Federal Capital Territory (FCT). Others include: 49 (11%) who reside in the North-West, 57 (13%) who reside in the North-East, 64 (14%) who reside in the South-West, 27 (6%) who reside in the South-South, and 19 (4%) who reside in the South-East. There are no respondents who reside in Yobe (North-East), Jigawa and Kebbi (North-West) states, and only one (1) respondent each who reside in Bayelsa (South-South), Ekiti (South-West) and Enugu (South-East), participated in the survey, which are shown blank on the map (Figure 1).

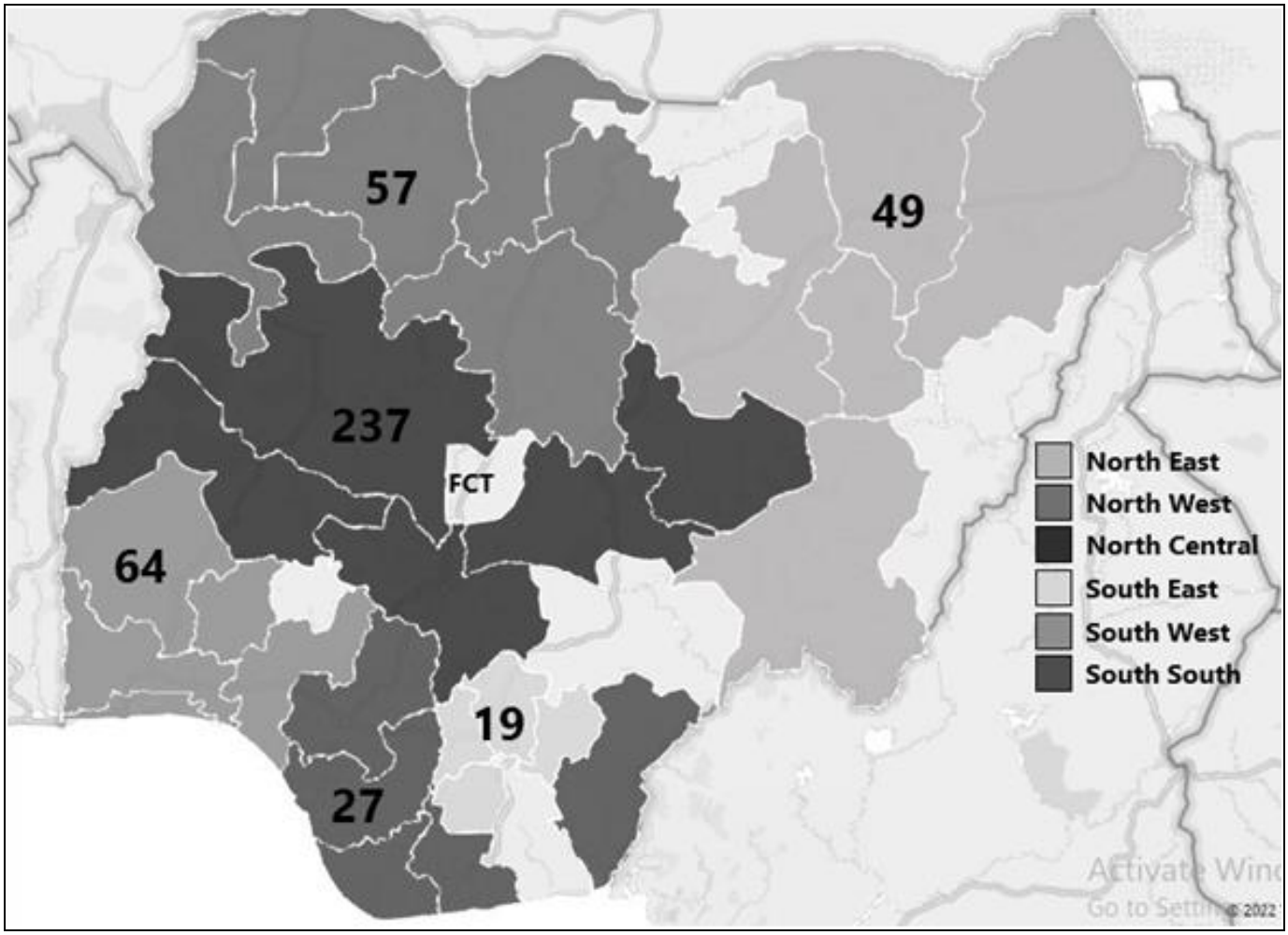

Fig 1: State of residence of respondents by geographical zones

The demographic information of respondents from the survey is shown in Figure 2. Majority (38%) of the respondents are in the 15-29 age group, 32% are of 30-44 age group and 23% are of 45-59 age group (Figure 2-I). Only a few (36%) are healthcare providers (Figure 2-III). Fifty-four percent of the respondents are married and 43% are singles (Figure 2-IV). In addition, the survey shows that the respondents are highly educated, 55% of them have obtained their tertiary education and 38% have completed their postgraduate studies (Figure 2-V).

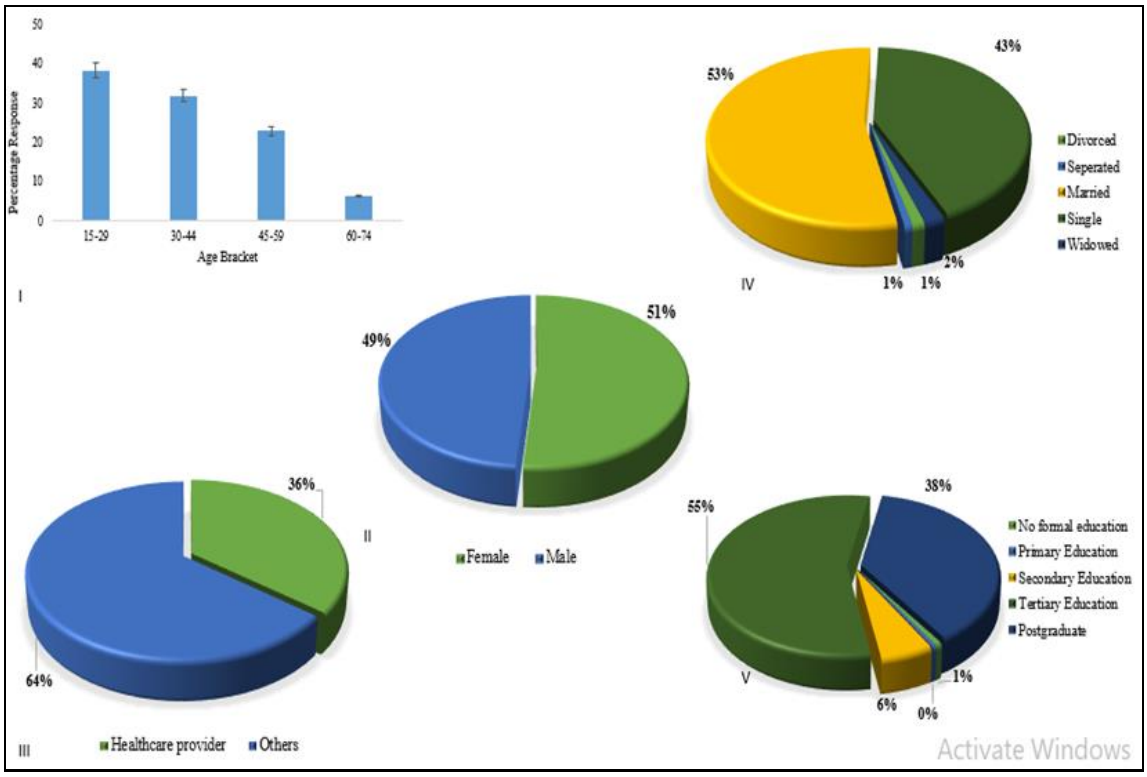

Fig 2: Demographic information of respondents; (1) Age group; (II) Gender; (III) Profession; (IV) Marital status; (V) Educational qualification

3.2 General information on herbal medicines

3.2.1 Use of herbs for prevention of COVID-19

Figure 3(I) shows that 153 (35%) of respondents used herbs to prevent COVID-19. Traditional herbal medicines are widely accepted in the world [19], and in Nigeria, 82% of the population use herbal medicines [20]. The emergence of the novel Corona virus disease (COVID-19) came as a global public health crisis, affecting every part of the globe with mild to moderate symptoms [21]. It is characterized by respiratory symptoms (dry cough, nasal congestion, runny nose, and sore throat), fever, aches, pains, and diarrhea, to more severe symptoms especially with the elderly and those with underlying chronic diseases such as cardiovascular disease, diabetes, chronic respiratory disease, and cancer [2]. By affecting the global public health sector, this viral infection has created a disastrous situation associated with high morbidity and mortality rates along with remarkable cases of hospitalization because of its tendency to be highly infective. These challenges led to the use of medicinal plants for prevention of the disease and forced researchers and leading pharmaceutical companies to find and develop cures for this novel strain of coronavirus [22]. A study conducted by Olapegba *et al.*, (2021) [23] showed that 11.86% of respondents used herbal medicines to prevent COVID-19, while in Peru, 80% of the respondents used medicinal plants to prevent COVID-19 [24].

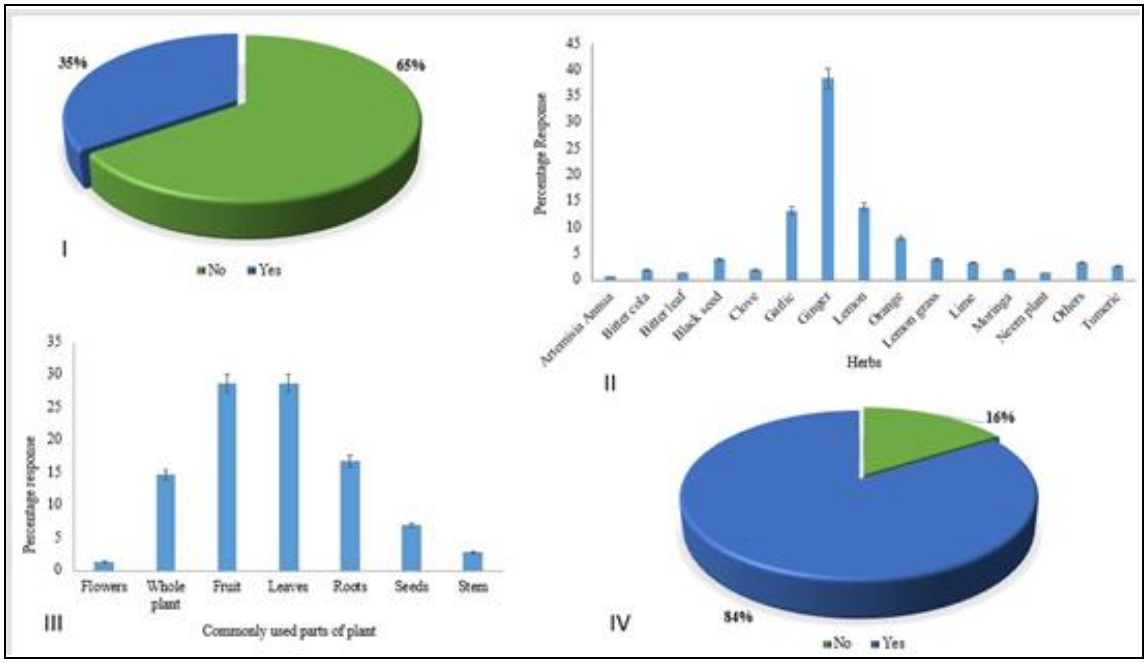

Fig 3: Information of respondents who used herbal medicines for prevention of COVID-19; (I) Use of herbal medicines in COVID-19; (II) Common herbs used by respondents; (III) Commonly used parts of plants; (IV) Respondents who used a combination of herbs

3.2.2 Herbs used by respondents for the prevention of COVID-19

Figure 3(II) shows the herbs used by respondents to prevent COVID-19. Most of the respondents (38%) used ginger (*Zingiber officinale*), while 13% and 14% of the respondents used garlic (*Allium sativum*) and lemon (*Citrus limon*) respectively. Ginger and garlic have been shown to have anti-inflammatory, antioxidant, analgesic and immunomodulatory properties [25, 26]. And studies have shown the antibacterial properties of ginger [27], which has found usefulness in treating cough and cold [26]. Chukwuorji and Iorfa (2020) [28] also noted that these herbs (lemon, ginger, garlic and other local herbs) were consumed out of fear of been infected with the virus, while Villena *et al*. (2021) [24] showed their use in preventing/treating COVID-19. Clove (*Syzygium aromaticum* L.) is a famous culinary spice used in traditional medicines and to treat many illnesses. Our study shows that only 2% of the respondents used cloves, however, 20% of the respondents used it in combination with other herbs to prevent COVID-19 (Table 1). Vicidomini *et al*. (2021) [29] reported that cloves are a good source of beta carotene, B vitamins (B1 and B6), other vitamins (A, C and K) and riboflavin. They were also shown to boost immunity and improve the body's resistance to diseases due to their anti-inflammatory, immune-stimulatory, antibacterial, antimicrobial and antithrombotic properties, hence its use in the prevention of COVID-19 [30]. Gbadamosi (2020) [16] also mentioned lemon grass (*Cymbopogon citratus*), Neem (*Azadirachta indica*), and Turmeric (*Curcuma domestica*) as helpful herbs for the prevention of COVID-19.

3.2.3 Parts of plants used by respondents

Figure 3(III) shows that fruits (29%) and leaves (29%) were the most commonly used parts of plants for the prevention of COVID-19. The Corona virus disease (COVID-19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [31]. It is characterized by cough, weakness, taste disorders, and fever [32]. According to Yuki *et al*. (2020) [33], COVID-19 patients were classified according to presenting symptoms such as mild cases (fever, fatigue, myalgia, cough, sore throat, runny nose, sneezing), moderate cases (frequent fever, cough), severe cases (pneumonia with oxygen deficiency) and critical cases (Acute respiratory distress syndrome). In a study conducted by Mailu *et al*. (2020) [34] on the use of herbs in the treatment of respiratory diseases, they showed that leaves (33%) were the commonly used part of plants while Lawal *et al*. (2020) [35] reported that leaves (36%) were the major plant part recommended for cough. In addition, Ahvazi *et al*. (2012) [36] reported in their study that the use of fruits and leaves were the same and Zerabruk and Yirga (2012) [37] stated that leaves (28%) were the most common part of plant used by respondents. In the present study, 15% of the respondents used whole plants, which is in line with a study conducted by Chaachouay *et al*. (2020) [38]. Besides the use of various plant parts to prevent COVID-19, most of the respondents (84%) also combined these herbs as seen in Figure 3(IV). This may be due to the synergistic effects of the different active metabolites present in these herbs against micro-organisms [39]**.** The mode of action of the corona (SARS-Cov 2) virus includes hyper-inflammatory responses which triggers immunosuppressive reactions with a resultant damage to the lungs, hence, the need for a combination of herbs [40]. Another study conducted by Ayoola *et al*. (2020) [63] showed that the respondents used a combination of herbs for the prevention of COVID-19. This study is also in line with the study conducted by Shankar *et al*. (2020) [42], and Chaachouay *et al*. (2020) [38] concluded that these combined herbal mixtures be validated as promising therapeutic alternatives for the prevention/treatment of COVID-19. Some of the combination of herbs used by respondents in this study is listed in Table 1 below, and it can be observed that ginger, garlic and lemon or lime were the predominantly combined herbs used for the prevention of COVID-19.

Table 1: Some combination of herbs used by respondents to prevent COVID-19

S/No.	Combination of herbs	Frequency	Percentage (%)
1	Artemisia annua, ginger, pawpaw leaves, cloves and vervain plant	1	1
2	Bitter kola, ginger, lemon and lime	1	1
3	Bitter leaf, moringa, lemon grass	1	1
4	Garlic and moringa	1	1
5	Garlic, Artemisia and black seed	1	1
6	Garlic, black seed, turmeric and lemon	1	1
7	Garlic, lemon and honey	1	1
8	Garlic, moringa and lemon	1	1
9	Garlic, moringa and turmeric	1	1
10	Ginger and garlic	1	1
11	Ginger and lemon	1	1
12	Ginger and lime	2	2
13	Ginger and turmeric	1	1
14	Ginger, bay leaves, guava leaves, soursop leaves, and lemon grass	1	1
115	Ginger, black Seed and neem leaves	1	1
116	Ginger, cloves, black seed oil, honey, turmeric and oranges	1	1
17	Ginger, cloves, cinnamon, green tea, and honey	1	1
18	Ginger, cloves, turmeric, lime, lemon	1	1
19	Ginger, garlic and cloves	1	1
20	Ginger, garlic and honey	1	1
21	Ginger, garlic and lemon	8	8
22	Ginger, garlic and lime	7	7
23	Ginger, garlic and turmeric.	4	4
24	Ginger, garlic, neem leaves, lemon grass, bitter leaves, scent leaves, lemon and honey	1	1
25	Ginger, garlic, cloves and black seed	1	1
26	Ginger, garlic, guava leaves and lemon	1	1

27	Ginger, garlic, lemon and clove	2	2
28	Ginger, garlic, lemon and honey	4	4
29	Ginger, garlic, lemon and lime	3	3
30	Ginger, garlic, lemon and neem leaves,	1	1
31	Ginger, garlic, lemon grass, turmeric, mango, moringa, orange, pawpaw and guava leaves	1	1
32	Ginger, garlic, lemon or Tamarind	1	1
33	Ginger, garlic, lemon orange and pineapples	1	1
34	Ginger, garlic, lemon, clove, turmeric, black seed and honey	1	1
35	Ginger, garlic, lemon, lemongrass	2	2
36	Ginger, garlic, lemon, onions and neem	1	1
37	Ginger, garlic, lemon, turmeric and black pepper	1	1
38	Ginger, garlic, lemon, turmeric and cloves	1	1
39	Ginger, garlic, lemon, turmeric and lemon grass	1	1
40	Ginger, garlic, lemon, turmeric, honey, aloe vera, clove, smoothies, raw fruits.	1	1
41	Ginger, garlic, lime and honey	1	1
42	Ginger, garlic, lime, lemon grass and honey	1	1
43	Ginger, garlic, lime, lemon grass, turmeric, and neem plant.	1	1
44	Ginger, garlic, onions	1	1
45	Ginger, garlic, scent leaf and bitter leaf	1	1
46	Ginger, garlic, scent leaves, bitter leaf, bitter cola	1	1
47	Ginger, garlic, turmeric and cloves	1	1
48	Ginger, garlic, turmeric and honey	1	1
49	Ginger, garlic, turmeric and lemon	2	2
50	Ginger, garlic, turmeric, and apple cider vinegar	1	1
51	Ginger, garlic, turmeric, black seed, honey	1	1
52	Ginger, garlic, turmeric, lemon, cloves, lemon grass, udah (*Xylopia aethiopica*), black seed	1	1
53	Ginger, garlic, turmeric, lemon, lemon grass and cloves.	1	1
54	Ginger, garlic, turmeric, lemonade,	1	1
55	Ginger, honey, cloves, garlic, limes	1	1
56	Ginger, lemon and bitter leaf	1	1
57	Ginger, lemon and onions	1	1
58	Ginger, lemon, cloves	1	1
59	Ginger, lemon, cloves, honey	1	1
60	Ginger, lemon, cloves, turmeric and eucalyptus	1	1
61	Ginger, lemon, garlic, Artemisia, black seed	1	1
62	Ginger, lemon, lemon grass and cloves	1	1
63	Ginger, lemon, lemon grass and honey	1	1
64	Ginger, lemon, lemon grass, garlic	2	2
65	Ginger, lemon, oregano, neem plant	1	1
66	Ginger, lemon, turmeric and honey	1	1
67	Ginger, lemon, turmeric, black pepper, cinnamon and honey	1	1
68	Ginger, lime, lemon and clove	1	1
69	Ginger, lime, lemon, Grape	1	1
70	Ginger, lime, lemon, turmeric, pineapple, neem, cinnamon, pawpaw, and lemongrass	1	1
71	Ginger, lime, onion and orange	1	1
72	Ginger, moringa, turmeric, clove and mint	1	1
73	Ginger, turmeric, black seed, clove and cinnamon	1	1
74	Ginger, turmeric, clove and lemon	1	1
75	Lemon grass, pawpaw leaves, and lime	1	1
76	Lemon grass, lemon, mango leaves, sent leaves, better leaf, curry leaves, avocado leaves, soursop	1	1
77	Lemon grass, pawpaw leaves, neem leaves	1	1
78	Neem and pawpaw leaves	1	1
79	Orange and ugwu leaf	1	1
80	Pineapple peel and mango leaves	1	1

3.2.4 Combination of plant parts used by respondents and their mode of preparation

Figure 4(I) shows that 73% of the respondents combined different plant parts to prevent COVID-19, while 54% of the respondents took the herbal medicines in the form of teas, followed by herbal liquid mixtures (19%). Other forms in which herbs were used in this present study, are in the form of spices (5%), as steam inhalation (7%), as herbal syrups (3%), and unprocessed (7%) as shown in Figure 4(II). Okoh *et al*., (2016) [20] reported that 54% of their respondents took herbal medicines in liquid form, stating that the respondents preferred the liquid dosage forms of herbal medicines compared to other dosage forms. The use of spices has played a very significant role in humans. One major medicinal uses of these spices (ginger, turmeric, cloves) have been as expectorants in time past [43]. According to Jiang (2019) [44], medicinal herbs that are used as spices possess antioxidant, anti-inflammatory, anti-tumorigenic, antimicrobial and anti-carcinogenic properties due to the presence of sulfur-containing compounds, tannins, alkaloids, phenolic diterpenes, flavonoids and polyphenols. He added that the regular ingestion of these herbs was connected to low mortality rates due to cancer and respiratory infections, no wonder it was consumed to prevent COVID-19. Besides their use for medicinal purposes, they are also used to enhance the appearance of foods and to serve as preservatives [45]. Steam

inhalation is a traditional method utilized to ease colds and upper respiratory tract infections, due to its ability to loosen mucus, open nasal airways and reduce mucosal inflammation [46]. Chowdhury *et al*., (2022) [47] reported that the inhalation of steam causes a stress-like mechanism in the lungs that increases the lung's breathability, reduces congestion, increases tidal volume, vital capacity, airflow, and the forced expiratory lungs volume, in addition to strengthening immunity and improve mucociliary clearance. In India, Anam *et al*., (2021) [48] showed the efficacy of herbal inhalation in inactivating the SARS-CoV-2 virus., and they listed ginger, clove, citrus fruits as some of the herbal remedies used for steam inhalation during the pandemic, including neem, paw and guava leaves [49].

3.2.5 Prescriber information on use of herbs by respondents

The current study shows that 38% of the respondents engaged in self-medication to prevent COVID-19, while 30% and 22% of them indicated that the herbal medicines were prescribed by their families and friends respectively. According to WHO (2000) [50], self-medication practices is the use of medicinal products by a consumer to treat self- recognized illnesses or symptoms, or the recurrent or persistent use of a medication prescribed by a physician for chronic or recurring diseases or symptoms. The survey conducted by Okoh *et al*., (2016) [20] in Nigeria showed that 23% of respondents practiced self-medication using herbal medicines, while in Togo, about 34% of the respondents were reported to engage in self-medication practices to prevent COVID-19 [51]. In a study conducted by Sim *et al*., (2013) [52] in Australia, it was reported that families and friends played a vital role in the prescription of herbal medicines. Also in Kenya, a high frequency of respondents who engaged in self-medication and sourced information from families and friends were reported [53]. In the case of COVID-19, the recommendations on the use of herbal medicines largely came from families, friends, and health professionals [54]. Furthermore, the current study showed that only 2% of respondents got their information from herbalists, which correlates with another study where only 5% of their respondents received information from herbalists [55].

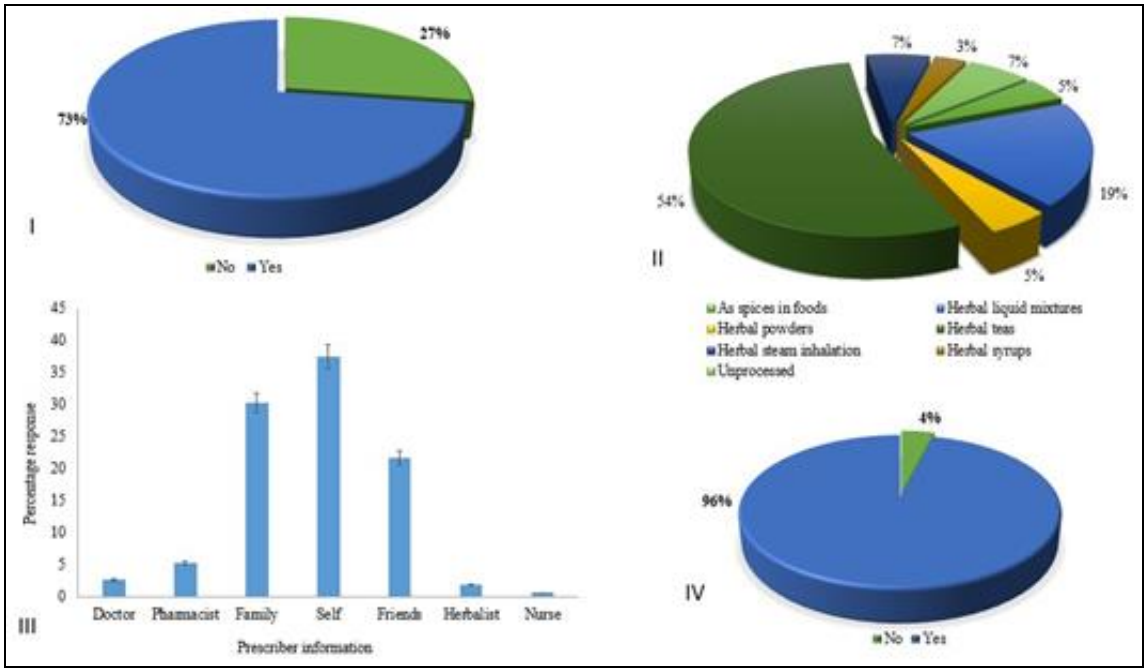

Fig 4: Efficacy and Prescriber information on herbal medicines use; (I) Respondents who combined parts of plants; (II) Form in which herbal medicines were taken by respondents; (III) Prescriber information; (IV) Information on efficacy of herbal remedies

3.2.6 Development of herbal medicines for the prevention of COVID-19

Herbal medicines occupy a strategic position in the healthcare delivery system especially in Africa due to their accessibility, availability, little side effects and cost-effectiveness [56]. Figure 5(I) shows that 87% of respondents recommended the development of herbal medicines for treatment/prevention of COVID-19. In South Korea, herbal remedies were recommended for the prevention of SARS-CoV-2 virus, adding that the herbal remedies will serve as treatment options for future diseases [57]. In China, the role of the Traditional Chinese Medicine (TCM) in treating mild, moderate to severe cases of COVID-19 were reported, and so, it was recommended that the use of herbs be incorporated in the fight against the virus [58]. Similarly, In Nepal, a study showed that the use of herbal medicines increased during the pandemic, with most respondents endorsing its use as it played a vital role in preventing the disease [59]. Silveira *et al*., (2020) [17] suggested that the use of these herbs may enhance the health and well-being of those affected by the virus, even though it may not completely eradicate the disease.

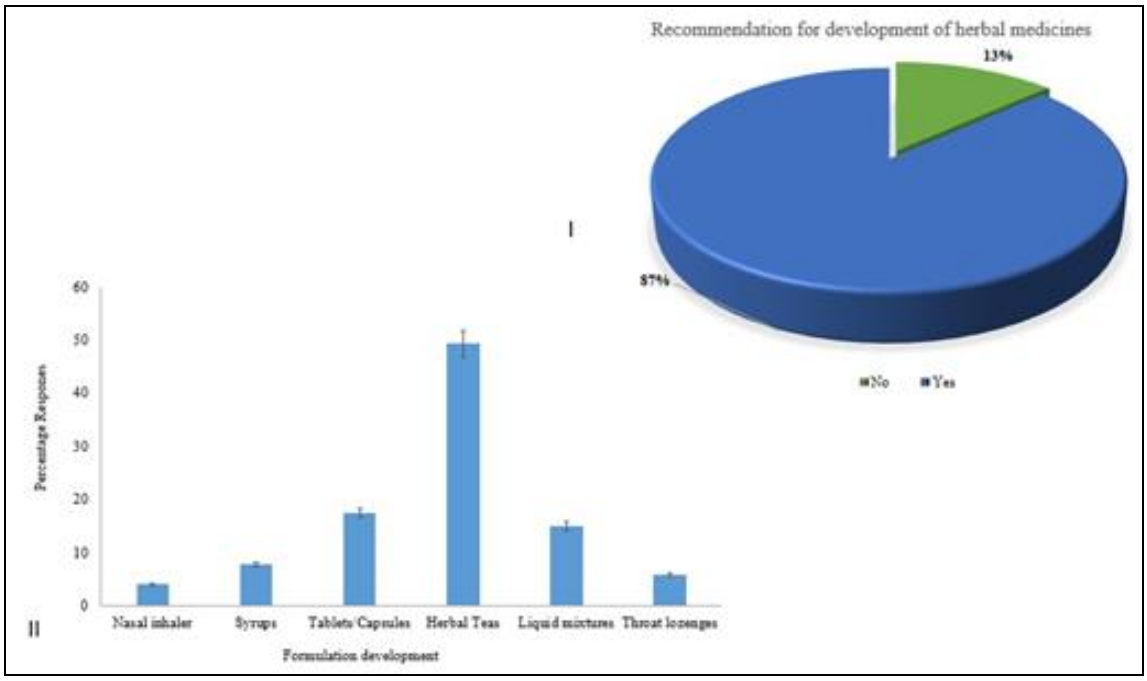

Fig 5: Responses for the recommendation (I), and formulation development (II) of herbal medicines

Following the recommendations made by the respondents, 49% of them preferred that the herbal remedies be formulated as teas, while 18% and 15% of them recommended tablets/capsules and liquid herbal mixtures respectively (Figure 5-II). Herbal teas can be termed as a combination of dried leaves, seeds, grasses, nuts, barks, fruits, flowers, etc that gives them their taste and provide the benefits of herbal mixtures and are most appropriately called tisanes [60]. These herbal teas are used as therapeutic vehicles prepared as infusions in either cold or hot water to extract its active principles and taken when necessary [61]. Vicidomini *et al.*, (2021) [29] reported that the intake of teas was a common way to treat respiratory diseases such as cough and cold, and [62] reported that aromatic herbal teas could ward off viral infections, especially the SARS CoV-2 virus.

Table 2: Some suggestions and recommendations from respondents

S/No	Suggestions and recommendations from respondents
1	Africa should use and develop her own native cure for the pandemic
2	Collaborative research and government commitment is important
3	Detailed further research is essential
4	Federal government and NAFDAC should deliberately encourage research/use of herbal medicines. This will provide raw material for pharmaceutical industries and reduce
5	Taste of herbal medicines should be improved
6	Government-enabled financial support for research and development in the production of indigenous vaccines
7	Greater research and awareness campaign of herbal medicines should be done
8	Herbal medicine could help in preventive efforts
9	Herbal medicines should be promoted and publicized
10	Herbal medicines should be standardized
11	Herbal preparations should be produced to manage COVID-19
12	Local capacity in the development of herbal remedies should be supported
13	Herbal treatment for COVID-19 should be given a chance
14	Herbal medicines should be made available as soon as possible
15	Government should fund herbal medicine production in order to reach the masses
16	Increase education and awareness of herbal medicines
17	It should be affordable and safe
18	Nigeria is endowed with a lot of herbal remedies which should be harnessed by the government to increase awareness, improve health and also for economic growth
19	NIPRD should develop appropriate medication for COVID-19
20	Please treat as urgent by developing the solution to COVID-19 through herbal medicines
21	Combination of plants root, stems, fruits, leaves and flowers should be taken in multiple forms including spices in food to boost immunity
22	There should be more herbal health centers
23	There should be regulation on consumption as self-medication is on the increase
24	There's need for openness, collaboration and trust among researchers in Nigeria and Africa if we are to minimize dependence on Western medications
25	We should formulate them and reach out to the local communities and create awareness using available channels
26	We should have a made in Nigeria solution to a global problem

4. Conclusion

This study shows that a good number of the respondents used herbal medicines to prevent COVID-19, and also gives an insight into the formulation development of possible herbal medicine-based therapy for future consideration in the fight against the virus.

5. Acknowledgment

The Authors are thankful to the Director General of National Institute for Pharmaceutical Research and Development (NIPIRD), for the financial support to carry out this study.

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