Potential use of Eastern Hararghe Ethiopia medicinal plants for COVID-19-like symptoms: A review

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Abstracts: The world is in a great war with the rapidly and exponentially spreading virus, the corona virus disease (COVID-19). To win this pandemic, pharmaceutical companies and scientists are in a tight race to get modern vaccines or drugs. Following such efforts, dexamethasone (one of the known corticosteroids) has shown hopeful potency against the pandemic corona virus disease (COVID-19) as per the WHO updated report. However, till the development of this review study, no single anti-COVID-19 drug/or vaccine has fully been announced yet. Hence, for a time being, the world has been forced to turn its face towards alternative phyto-medicines. Accordingly, scholars by now have recommended plant lead traditional medicines as first aid kits to minimize the impact of corona virus pandemic. In this review paper, an attempt is made to introduce some selected possible antiviral medicinal plants found in the Eastern Hararghe region of Ethiopia. We focused on those plant species which have routinely been used by the local community to treat infectious diseases such as flu, cold, cough, sore throat, headache, pneumonia, lung abscess, fever, malaria, asthma and related viral infections. A total of 33 plant species from different families (Fabaceae is the dominant one, 18.18%) were reviewed. Since the above mentioned infections are symptomatically similar to that of COVID-19, the plant species reviewed in the present paper may have a potential to treat and control the surging corona virus pandemic. This review may therefore provide useful information about the antiviral therapeutic uses of most preferred medicinal plants of Eastern Hararghe, Ethiopia. The present review may serve as an input to the research and development of antiviral agents in the future.

Keywords: Antiviral medicines, COVID-19, Ethiopian traditional medicine, Traditional medicinal plants, viral infection

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Introduction

It is known that COVID-19 pandemic nowadays is the threat of the world in which its spreading is very rampant and uncontrollable. Our intention here in this paper is not to narrate about the entire features of the pandemic and what the data recorded thus far look like, since many things have been said elsewhere. Nevertheless, it is necessary to say a little bit about the extensive measures which are being taken globally to reduce and/or stop the transmission of COVID-19 if not to eradicate it from the face of the world. Currently, pharmaceutical companies, academia, research institutions and even traditional healers are in a tight race to hunt possible medicines against the corona virus pandemic. Of which the drug companies have spent thousands of millions of money to get an effective and-safe anti-corona virus drug either by developing a new one or repurposing those which are already in the market (Dubey & Dubey, 2020). Thus far, dexamethasone, one of the known corticosteroids, has been recommended as COVID-19 caused death reducer (one-third) as per the WHO report (Ledford, 2020).

But till the development of this review, no single drug or vaccine has been declared to set the world free from the COVID-19 arrest as per the WHO announcement (Aanouz et al., 2020). If this is so, what should we do? Which one is our hope? To us, the world should turn its face towards the traditional medicine as the human kind has a strong familiarity with nature-based medications since time immemorial. It is also known that such traditional medical practices are the eye openers for the modern medicine for searching new drugs, leads and new chemical entities (Dubey & Dubey, 2020). The botanical sources are the one which are in the front line of traditional medications, in which phytomedicines/ or herbal medicines have been found to be effective in reducing various ailments and were the only safeguards of the world's health care system before the introductions of antibiotics including antiviral drugs (Khaerunnisa, Kurniawan, Awaluddin, Suhartati, & Soetjipto, 2020). Now once again, those traditional medicinal plants should be our first choice to tackle the corona virus pandemic in two ways.

Firstly, as there are no specific vaccines and effective drugs for the treatment of COVID-19, plant species having a back history of treating various infections especially as anti-viral can still be used as first aids against the corona virus pandemic (Aanouz et al., 2020; Hassan, 2020).

Researchers currently encourage/or recommend the world to use traditional medicinal plants and herbal medicine to defend COVID-19; and such recommendation has been highly applied in those countries having a long history of using traditional medicines such as China, India and some other developing countries (Zhang, Wu, Zhang, Deng, & Peng, 2020). However, much attention should be given to the selection and use of traditional medicinal plants against COVID-19; i.e. those plant species recommended for the treatment of corona virus pandemic should have a potential history of treating viral infections or infections having COVID-19 like symptoms. According to the statements declared by WHO and other scholars, fever (a temperature higher than 37.5 degrees), a dry cough, sore throat, runny nose, fatigue, headache, diarrhea, shortness of breath, loss of taste and smell are the most common symptoms of COVID-19 (Ang, Lee, Choi, Zhang, & Lee, 2020).

Secondly, beyond their traditional therapeutic uses against various viral infections, medicinal plants are reservoirs of untold numbers of chemical staffs in which their contribution to the modern drug discovery and development (MDDD) is invaluable. Plant species play a crucial role in the modern health system either by providing new, safe and effective drugs or as sources of lead compounds (which later can be used as starting materials in drug development) (Egamberdieva, Mamedov, Ovidi, Tiezzi, & Craker, 2017). This is the reason why researchers have spent their precious time and effort on searching effective drugs against spreading infections including viruses. The effort has still been continued as far as the outbreaks of viral diseases are on the place, in which the emergence of COVID-19 is one assertion. The faith in herbal medicine (as alternative therapies) has once again been revived for the re-exploration of anti-viral drugs. (Ahmad, Rehman, & Alkharfy, 2020). Aromatic herbs, medicinal plants and their bioactive constituents have potential to inhibit viral replication (Boukhatem & Nadjib, 2020). The plant-originated antiviral compounds reported thus far can be considered as signals to focus on those antiviral plant sources to search anti-COVID-19 compounds. This is because antiviral compounds isolated from botanical sources are enormous in number and an extremely diverse chemical compounds, which represent a great potential for the discovery and development of new antiviral agents with broad spectrum of activity (Mukherjee, 2019; Singh, Gupta, Mishra, & Mishra, 2020). Hence, by taking advantages of the less toxicity effect, ease affordability and

diverse chemical staff with multi-activities and complex structures, the role of traditional medicinal plants in bioactive drug discovery including anti-COVID-19 agents is ever lasting.

Here, the take home message is a serious attention, awareness, understanding and knowledge should be given to traditional medicinal plants to use them as first aid kits and long term solution (as sources of new drug) against the ongoing pandemic COVID-19.

In the developing countries including Ethiopia, lifestyle associated infectious diseases together with economic problems, are become the big challenges to the country's health system. To overcome such transmitted diseases including the respiratory one such as colds, flu, pneumonia, etc., the community heavily relays on traditional plant medicines thereby improving their quality of life, with a focus on disease prevention (Moges, 2020). Eastern Hararghe of Ethiopia is one of the historic provinces in the country, which are very rich in flora biodiversity. The communities in this area have an adequate indigenous knowledge of traditional medicines and long history of using medicinal plants against various human and animal ailments. Most of the traditionally useful plant species reported in Eastern Hararghe of Ethiopia are used to treat infections showing similar symptoms as to COVID-19; in which flu, cough, cold, pneumonia, noise and throat infections are few of them (A. Belayneh & N. F. Bussa, 2014).

Our intention in this review paper is therefore, to let know some of the most selected medicinal plants found in the Eastern Hararghe part of Ethiopia by reviewing their botanical and ethno-botanical aspects. We believe that as the plant species reviewed in the present paper are used as remedies against diseases symptomatically similar to COVID-19, they may possibly have a capability of curing the corona virus pandemic either as alternative traditional medicine (in the form of formulation, herbal preparation and capsulation) or as sources of anti-viral agents. Moreover, this may be a golden opportunity to Eastern Hararghe community as well as to the rest of the world if a great attention is given.

Methodology

The article and/or review papers mentioned in the present review were collected from different searching data bases such as Science Direct, Web of Science, Scopus, Google Scholar, BioMed Central (BMC) and Springer using the key words and/or phrases like "COVID-19", "traditional medicinal plants", "plants in Eastern Hararghe","viral infections", "medicinal plants in Ethiopia", "COVID-19 and traditional medicines", "flu and corona virus". Our searching method mainly focused on peer-reviewed journals dealing with the ethno-medicinal plants of Eastern Hararghe, Ethiopia used to treat flu, cold, respiratory and other viral infections. Journals included in this review paper are those published until November 2020.

Traditional Medicinal Plants in Ethiopia

In Ethiopia, about 6500-7000 higher plant species are expected to be found as reported in the flora of the country. Of which, close to 800-1000 plant species are being used in the traditional health care system making the country one of the most diverse floristic regions in the world(Bultum, Woyessa, & Lee, 2019; Demie, Negash, & Feye, 2018).

These medically important plant species have various therapeutic uses for a long time to cure various human and animal ailments. According to (Teklehaymanot, 2009), for instance, such already known medicinal plants have routinely been applied to treat nearly 300 mental and physical disorders. In total, about 80% of Ethiopian population depends on traditional medicinal practices to safeguard their life from various diseases; of which more than 95% of the traditional medicinal preparations are based on medicinal plants (A. Belayneh & N. Bussa, 2014; Mengistu, Kebede, Oncho, Abebe, & Alemnie, 2019). The mode of preparation of the plant species can be in different forms like in the form of powder, decoctions, oil, alcohol, tincture and capsulation.

Eastern Hararghe, one of the districts in Ethiopia, is very adequate in plant diversity in which its indigenous community uses plenty of medicinal plants as traditional medicine. The pastoral and agro-pastoral communities of this place highly rely on such traditional medicinal plants to treat human and livestock infectious diseases. According to (Belayneh, Asfaw, Demissew, & Bussa,

2012; A. Belayneh & N. Bussa, 2014) report, a total of 51 plant species were documented as traditional medicinal plants against human ailments in the Erer valley of Babile wereda and about 83 plant species were surveyed from Harla and Dengego Valleys of Eastern Hararghe. Harla and the entire catchment areas are the prehistoric places where the Oromo people currently inhabit. It is believed these people might be the descendants of the former Harla people of the Harla kingdom, which had been ruled between 13th to 16th centuries. The Harla kingdom is expected to be the guardians of valuable indigenous knowledge on the use of traditional medicinal plants of their surroundings. There is even an endemic plant species named after this prehistoric place called *Aloe harlana* Reynolds due to its availability only in Harla place(A. Belayneh & N. Bussa, 2014). In general, the share of medicinal plants and the value of the associated indigenous knowledge of the community from such places are expected to be high. In the present review paper, we made a botanical and ethno-botanical review on a total of 33 plant species found in the Eastern Hararghe province, Ethiopia. The medicinal plant species presented in this review are those which have routinely been used to treat COVID-19 like infectious diseases (in terms of symptoms) in the mentioned area. Headache, cough, cold, malaria, sore throat, pneumonia, abdominal pain, diarrhea, etc., are some of the infections in which the reviewed plant species in this paper used for. The botanical and vernacular name, family, habitat, diseases treated, parts used and methods of preparation of the plant species reviewed in the present work is presented in the following table.

Table 1: Possible anti-corona virus disease (COVID-19) medicinal plants found in Eastern Hararghe, Ethiopia.

No.	Scientific name	Family	Vernacular name	Hb.	Disease treated	PU	Method of preparation	References
1.	*Acacia brevispica Harms*	Fabaceae	Hamaresa (Or)	Sh	Headache, cough and fever	L	Leafs are soaked in water for infusion, and drunk hot infusion	(Belayneh et al., 2012; A. Belayneh & N. Bussa, 2014)
2.	*Acacia robusta Burch.*	Fabaceae	Wangeyo (Or)	T	Malaria	R, S	Decoction of the powdered stem bark or root	(Belayneh et al., 2012)
3.	*Acacia tortilis (Forssk.) Hayne*	Fabaceae	Tadacha (Or)	T	Throat infection stomachache cough, colds and diarrhea	L B	Concoction Hot infusion	(Belayneh et al., 2012)
4.	*Aframomumcorrorima Braun P.C.M. Jansen*	Zingiberaceae	Korarima (Amh)	H	Headache, stomachache, sore throat, cancer, asthma and diabetes	S	Crushed seeds in the drink Ingredient spices	(Kandari, Negi, Thakur, & Yilma, 2015)
5.	*Allium sativumL*	Alliaceae	Qulubi-adii (Or)	B	Cough, lung abscess, cold, influenza, diabetes and headache	B	Crushed, homogenized taken with tea or water and drunk	(Wondimu, Asfaw, & Kelbessa, 2007)
6.	*Artemisia afra Jacq. exWilld.*	Asteraceae	Ariti (Or)	H	Stomachache, malarial,fever, coughs, colds, diabetes, sore throat, asthmaand headache	L	Grinded the leaves, soaked in water and drank, and sometimes chew the leaves	(Mengistu et al., 2019)
7.	*Artemisia abyssinicaSch. Bip. ex A. Rich*	Asteraceae	*Chikugn* (Amh)	H	Headache,cough, diarrhea pneumonia and abdominal pain	L	Grinded dried leaf,infusion with water and drank.	(Teka, Asfaw, Demissew, & Van Damme, 2020; Tsegay & Mazengia, 2019)

8.	*Azadirachta indica A. Juss*	Meliaceae	Kinina (Or)	T	Malaria, cough and malaria	B, L	Mixture of leaf or bark infusion and oil extracted from seed taken orally	(A. Belayneh & N. Bussa, 2014; J. Chen et al., 2018; Tefera & Kim, 2019)
9.	*Balanites aegyptiaca* (L.) Delile	Balanitaceae	Kulen (Or)	T	Influenza, cough, viral, malarial, headachediarrhea	L	Chewing for flue and smoking and inhaling	(Mulualem, 2017; Speroni et al., 2005)
10.	*Balanitesglabra Mildbr. &Schlecht.*	Balanitaceae	Kutka (Or)	T	Fever	R	Crushed thenboiled in water use aqueous decoction, concoction taken orally	(Belayneh et al., 2012)
11.	*Bersamaabyssinica Fresen.*	Melianthaceae	Qoracha (Or)	Sh	Cough, cancer, headache, stomachache, skin diseases, gonorrhea, malaria, fever diabetes and diarrhea	B, Fr L	Crushed part / Grinding, chewing, eating Bark juice	(Ibrahime et al., 2020; Mengistu et al., 2019; Tefera & Kim, 2019)
12.	*Commicarpus sinuatusMeikle*	Nyctaginaceae	Kontom (Or)	H	Throat infection	L	Concoction/Throat bath Oral	(Belayneh et al., 2012)
13.	*Dalbergiamelanoxylon Guill. &Perr.*	Fabaceae	Moghano (Or)	T	Fever, sore throat, headache , gonorrhea and asthma	R L	Mixed crushed parts of roots and leafs extract in hot water taken orally/drank	(Amri & Juma, 2016; Mengistu et al., 2019)
14.	*Dodonaea angustifolia L.F*	Sapindaceae	Edecha (Or)	Sh	Malaria, sore throat, fever, malaria, cold, arthritis and flue	F	Fresh fruits are eaten	(Asres et al., 2001; A. Belayneh & N. F. Bussa, 2014)
15.	*Dodonaeaviscosa (L.) Jacq.*	Sapindaceae	Etacha (Or)	Sh	Malaria, cough,fever influenza and cold	L	Soaked in hot water then inhalation of hot steam	(Mengistu et al., 2019; Teffo, Aderogba, & Eloff, 2010)
16.	*EchinopskeberichoMes fin*	Asteraceae	Kerebicho (Amh)	Sh	Malaria, cough, fever headache,typhus, mich, diarrhoea and stomach ache	R	Infusion and inhaling the smoke of burning plant	(Teklehaymanot, Giday, Medhin, & Mekonnen, 2007; Wondimu et al., 2007)

17.	*Eucalyptus globulusLabill*	Myrtaceae	Bargamo/barzafiadi (Or)	T	Cough, mich, asthma, malaria, sore throat,	L	The leaf is boiled and inhale the vapor/steam	(Amare & Getachew, 2019; Mworia, Kibiti, Ngeranwa, & Ngugi, 2020)
18.	*Heliotropium aegyptiacumLehm.*	Boraginaceae	Harma Deysa (Or)		Sore throat	L	Crushed, soaked then the filtrate is used for gargling the throat	(A. Belayneh & N. F. Bussa, 2014)
19.	*Indigoferacaerulea Roxb.*	Fabaceae	Gebeldiyo (Or)	Sh	Fever	R	Fresh root bark is crushed mixed with coffee, boiled then drank	(Mulualem, 2017)
					Malaria	L	The leaves pounded and boiled and then drank	
20.	*LepidiumsativumL*	Brassicaceae	Fexo (Or)	H	Malaria	S	Powdered seed mixed with *Allium sativum* bulbs and honey then takenorally	(Mengesha, 2016; F. Mesfin, Seta, & Assefa, 2014)
					Headache	S	Powdered seed with crushed seed of Ocimumlamiifolium is taken with coffee as drink	
					Cough, diarrhea and mich	L	Powdered leaf soaked in water then taken with coffee or tea orally	
21.	*Maeruaoblongifolia(Forssk) A. Rich*	Fabaceae	Je,e (Or)	Sh	Fever, cough	S	Crushed stem mixed with sheep fat and applied on the body and small amount of it is consumed	(Mulualem, 2017)
					Malaria	L	Pounded leaves macerated with goat milk and drank.	(A. Mesfin, Giday, Animut, & Teklehaymanot, 2012)

22.	*Mirabilis jalapa*	Nyctaginaceae	Udasalim (Or)	H	Fever, body weakness	R	Crushed root mixed with oil and applied on the whole body	(Mulualem, 2017)
23.	*Nigella sativa Linn.*	Ranunculaceae	Habsuuda gurrati (Or)	H	Asthma, inflammation, cough, headache fever, influenza and	S	Powdered dry seeds mixed with water then drank	(Ali & Blunden, 2003; Amare & Getachew, 2019)
24.	*Ocimum grattissimumL*	Lamiaceae	Suke (Or)	Sh	Headache, common cold, fever, respiratory tract infections and diarrhea	L	Fresh leaves soaked in hot water or tea and then drank/taken orally extracts	(Mengistu et al., 2019; Ueda-Nakamura et al., 2006)
25.	*OcimumlamiifoliumHochst. Ex Benth.*	Lamiaceae	Anchebi/Damakase (Or/Amh)	H	Cough , fever, malaria, relieve pain, wound, andinflammatory disorders	L	Crushed fresh leaves mixed with butter is taken with coffee and drank	(F. Mesfin, Demissew, & Teklehaymanot, 2009; F. Mesfin et al., 2014)
26.	*Osyris quadripartitaDecn.*	Santalaceae	Wato (Or)	Sh	Malaria,Stomachache, cough, swelling	R	Infusion resulted after 24 hours immersion is taken orally. Squeezing, powdering, liquid form and taken orally	(A. Belayneh & N. F. Bussa, 2014; Tefera & Kim, 2019)

27.	*PapeacapensisEckl. andZeyh.*	Sapindaceae	Biqaa (Or)	T	Problems in throat	B	Chewed the bark	(Wondimu et al., 2007)
28.	*Portulacaoleracea L. subsp.oleracea*	Portulacaceae	Merere Haree (Or)	H	Cough	L	Cooked and eaten as a demulcent agent	(A. Belayneh & N. F. Bussa, 2014)
29.	*Rhusnatalensis (Krauss)*	Anacardiaceae	Debobosso (Or)	T	Cough, fever	L	Decocted fresh leaves in waterand drank	(F. Mesfin et al., 2014)
					Malaria,	L	Decocted fresh leaves are drunk at morning for 3 days	
					Diarrhea	R	Extracts are mixed with water then drank	(Mengistu et al., 2019)
30.	*Rosa abyssinica R. Br.*	Rosaceae	Gora (Or)	Sh	Malaria, cough	R , F	Fresh parts grounded and extracts mixed with water and taken orally.	(Mengistu et al., 2019; W & Asres, 2008)
31.	*Terminalia brownii Fresen. Mus. Sen*	Combretaceae	Berensa (Or)	T	Headache, diarrhea, ulcers, cough, hepatitis, stomach ache Yellow fever	L B	Inhaled of extracts Concocted with bark of *Croton macrostachyus* and drank a cup of infusion	(A. Belayneh & N. F. Bussa, 2014; Mengistu et al., 2019)
32.	*Thymus schimperiRonniger*	Lamaceae	Masoleba or Tosegn (Amh)	H	Headaches, cough, cold and fever	H	Powdered boiled in water and tea then drank	(Desta et al., 2017)
33.	*Zingiberofcinale Roscoe*	Zingiberaceae	Zingibila (Amh)	H	Cough, fever, common cold, headaches, diarrhea and tonsillitis	R	Fresh crushed roots boiled with tea and then taken orally	(Wubetu, Abula, & Dejenu, 2017)

Hb – habitat, T – tree, Sh – shrub, H – herb, B – bulbous, and parts used (PU): R – root, S – stem, L – leaf, F – fruit, Or Afan Ormo, Amh – Amharic language

Table 2: Pharmacological and biological properties of some possible anti-corona virus disease (COVID-19) medicinal plants found in Eastern Hararghe, Ethiopia

No.	Scientific name	Extracts/ Active compounds	Pharmacological and biological properties	References
1.	Acacia brevispica Harms		No previous reported documents	
2.	Acacia robusta Burch.	Methanol extract leaves	Antifungal	(Hamza et al., 2006)
3.	Acacia tortilis (Forssk.) Hayne	Phenolic compounds and gallic acid esterified derivatives	Antibacterial, cytotoxic and anti-inflmmatory	(Ziani et al., 2020)
4.	*Aframomum corrorima* Braun P.C.M. Jansen	Methanol extracts of seeds, pods and essential oils	Antifungal and antioxidant	(Eyob, Martinsen, Tsegaye, Appelgren, & Skrede, 2008)
5.	*Allium sativum* L	Aqueous, methanolic, and ethanolic extracts and isolated compounds such as alliin, allicin, etc.,	Antiviral, anticancer, antioxidant, antidiabetic, anticytotoxicity, antiseptic, antibacterial, antifungal, antiasthmatic, anti-inflammatory and antihypertensive	(Batiha et al., 2020; Szychowski, Binduga, Rybczyńska-Tkaczyk, Leja, & Gmiński, 2018)

6.	Artemisia afraJacq.exWilld.	Ethanol (96%v/v) aerial part extracts and isolated compounds (scopoletin, acacetin and betulinic acid)	Ethanol (96%v/v) aerial part extract have potential of antioxidant, antimicrobial (antifungal and antibacterial) and cytotoxicity	(More, Lall, Hussein, & Tshikalange, 2012)
		Methanic, ethanilic extracts and volatile oils	Antiviral, anti-bacterial and anti-inflammatory	(N. Q. Liu, Van der Kooy, & Verpoorte, 2009)
7.	*Artemisia abyssinica* Sch. Bip. ex A. Rich	Essential oil, ethanol and extracts of the aerial parts	Anthelmintic, antispasmodic, antirheumatic, antibacterial, antioxidant, antileishmanial and antitrypanosomal	(Abad, Bedoya, Apaza Ticona, & Bermejo, 2012)
8.	Azadirachta indica A. Juss	Methanolic extracts of aerial parts	Anti-bacterial, anticancer, antioxidant, antidiabetic, antimalarial, anti-inflammatory, and antiseptic	(Jeba Malar et al., 2020)
		Aqueous extracts leaf	Antifungal and antiviral	(Olabinri, Adebisi, Odesomi, Olabinri, & Gbadebo, 2009)
9.	*Balanites aegyptiaca* (L.) Delile	Methanol and butanol extracts	Anti-inflammatory, antioxidant and anti-nociceptive	(Speroni et al., 2005)
		Aqueous ethanol (70%) bark extract	Anti-viral, antiseptic, anti-malarial and antisyphilitic	(Anani et al., 2015)
			possess antioxidant and antibacterial	
10.	Balanites glabra Mildbr. & Schlecht.		No previous reported documents	

11.	BersamaabyssinicaFresen.	Ethanol extract	Anti-malarial	(Suleman et al., 2018)
		Methanol and water extracts	Enzyme inhibitory and antioxidant	(Ibrahime et al., 2020)
		80% methanol	Antidiabetic	(Kifle & Enyew, 2020)
12.	CommicarpussinuatusMeikle		No previous reported documents	
13.	DalbergiamelanoxylonGuill.	Ethanol extract of bark	Anti-inflammatory, antianalgesic and antipyretic	(Kale, Misar, Dave, Joshi,
	&Perr.	Methanol and aqueous	Antibacterial and fungi	& Mujumdar, 2007)
		extracts of stem bark, root		(Amri & Juma, 2016)
		and leaf		
14.	DodonaeaangustifoliaL.F	Acetone extracted of aerial	Antibacterial and antifungal	(Omosa et al., 2014)
		parts and methylated		
		flavonoids		(Makonnen & Urga, 2012)
		Distilled water and 80%	Antimalarial	(Amabeoku, Eagles, Scott,
		methanol		Mayeng, & Springfield,
		Water extract	Antianalgesic and antipyretic	2001)

15.	Dodonaea viscose (L.) Jacq.	Alcohol and aqueous extracts of roots	Anti-diarrheal	(Rajamanickam et al., 2010)
		Methanol extract (80%) extracts of the leaves	Antiviral, antibacterial and anti-inflammatory	(Getie et al., 2003)
		Kaempferol methyl ethers and 3,4',5,7-tetrahydroxy flavone (kaempferol) from leaf	Antioxidant and antibacterial	(Teffo et al., 2010)
		Methanol, ethanol and chloroform extracts	Antidiabetic, cytotoxic , insecticidal, anti-ulcer, analgesic, antispasmodic, and detoxification	(Hossain, 2019)
16.	Echinops kebericho Mesfin	Essential oil, methanol and ethanol extracts leaf and roots	Antimicrobial, antihelmintic, antimalarial and molluscicidal	(Toma, Deyno, Fikru, Eyado, & Beale, 2015)
17.	*Eucalyptus globulus* Labill	Ethanolic extracts and Essential oil from leave and fruits	Antimicrobial, antioxidants, antiviral, anti-inflammatory, anti cancer, antiseptic, asthma, diabetes, arthritis and malaria	(Dezsi et al., 2015; Mahmoudzadeh-Sagheb, Heidari, Bokaeian, & Moudi, 2010; Vratnica, Djakov, Sukovic, & Damjanovic, 2011)

18.	HeliotropiumaegyptiacumLehm		No previous reported documents	
19.	*Indigoferacaerulea*Roxb.	Methanolic leaf extracts and Methyl gallat, rutin, isoquercetin, linoleic acid and β-sitosterol from fruits	Antioxidant, antimalarial and antibacterial	(Elmi et al., 2018; Guruvaiah, Arunachalam, & Velan, 2012)
20.	*Lepidium sativum* L	Seed oil	Antimicrobial, antioxidant and anti-inflammatory	(Alqahtani et al., 2019).
		Aqueous extracts of seed	Antihypertensive and diuretic effects	(Maghrani, Zeggwagh, Michel, & Eddouks, 2005)
21.	*Maerua oblongifolia* (Forssk) A. Rich	Dichloromethane/methanol and aqueous extracts	Antibacterial anti-fungal	(van Vuuren & Viljoen, 2006)
22.	*Mirabilis jalapa*	Alcoholic extracts leaf	Anti inflammatory	(Nath, Manjunath, Savadi, & Akki, 2010)
		Ethanolic extract of the aerial parts and root	Anti-oxidant	(Zachariah, Aleykutty, Viswanad, Jacob, & Prabhakar, 2011)
		Methanol extract from flowers	Antispasmodic	(Aoki, Cortés, Ramírez, Gómez-Hernández, & López-Muñoz, 2008)
		Methanolic extract	Antioxidant and antibacterial	(Walker et al., 2008; Zachariah et al., 2011).
		Hydroethanolic extract from leaves	Antiviral and antinociceptive properties of the plant also reported	
23.	*Nigella sativa* Linn.	Seed or black cumin essential oil, methanol and ethanol crude extracts	Anti viral, diabetes, cancers hypertension, oxidative stress, epilepsies, ulcers, asthma, inflammatory, disorders, fatty liver, and arthritis	(Khan, 1999; Majeed et al., 2020)

24.	Ocimum grattissimum L.	Flavonoid-rich alcoholic leaf extracts	Anti-inflammatory	(Ajayi et al., 2017)
		Essential oils leaf extracts	Antifungal, antileishmanial and antibacterial	(Kishore Dubey, Tiwari, Mandin, Andriamboavonjy, & Chaumont, 2000; Ueda-Nakamura et al., 2006)
25.	Ocimum lamiifolium Hochst. Ex Benth.	Ethanol extracts leaf	Anti-inflammatory	(Woldesellassie, Eyasu, & Kelbessa, 2011)
		Essential oils	Antibacterial	(Runyoro et al., 2010)
		Aqueous and ethanol extracts of leaves	Antipyretic	(Makonnen, Debella, Zerihun, Abebe, & Teka, 2003)
		Aqueous, methanol and crude chloroform extracts	Antimalarial	(Kefe, Giday, Mamo, & Erko, 2016) and
26.	Osyris quadripartita Decn.	Methanol and chloroform leaf extracts	Antimalarial	(Girma, Giday, Erko, & Mamo, 2015)
		Methanol (80%) leaf extract	Antidiarrheal, antioxidantand anti-inflammatory	(Teferi, Abdulwuhab, & Yesuf, 2019)
			Antibacterial, and antifungal	(S, Asres, & Gebre-Mariam, 2003)

27.	*Papeacapensis*Eckl. andZeyh.	Aqueous methanol (20%), ethyl acetate, flavonoids (quercetin-3-O-rhamnoside and epicatechin)	Antimicrobial, antioxidant and cytotoxicity	(Pendota et al., 2017)
28.	Portulaca oleracea L.subsp.oleracea	Ethanol (80%) aerial parts	Antioxidant and antibacterial	(Fan et al., 2019)
		Ethanolic (10%) extract of the aerial parts	Anti-inflammatory and analgesic	(Chan et al., 2000)
		Aqueous extract	Antioxidant activity	(B. Chen et al., 2012)
		Polysaccharides	Antidiabetic	(Bai, Zang, Ma, & Xu, 2016)
		Ethanol (80%) aerial parts	antioxidant and neuroprotective	(MARTINS et al., 2016)
29.	Rhus natalensis (Krauss)	Essential oils extracted from leaf	Antibacterial, antifungal and antioxidant	(Gundidza, Gweru, Mmbengwa, Ramalivhana, & Magwa, 2010)
		Ethyl acetate root extract and 3-((Z)-heptadec-14-enyl) benzene - 1-ol	Antioxidant and cytotoxic	(Matata et al., 2020)
		Ethanol and ethanol leaf	Antimalaria and anti-plasmodial	(Katuura, Waako, Tabuti, Bukenya-Ziraba, & Ogwal-Okeng, 2007)

30.	Rosa abyssinica R. Br.	Essential oil of the aerial, methanol, chloroform, acetone of leaf extracts	Antibacterial and antifungal	(Moustafa & Alrumman, 2015)
		Methanol (80%), roots	Anti-inflammatory and antinociceptive	(W & Asres, 2008)
31.	Terminalia brownie Fresen. Mus. Sen	Galloyl group extracts from stem bark	Antiplasmodial	(Machumi et al., 2013)
		Ellagic acid derivatived	Antibacterial and antifungal	
		Aqueous methanol (80%) bark extracts	Antimalarial	(Biruk et al., 2020)
		Aqueous (80%) methanol leaf extracts	Hepatoprotective, antioxidant and anticancer	(Sintayehu et al., 2017)
32.	*Thymus schimperi*Ronniger	Methanol (80%) leaf extract	Antioxidant potential	(Dessalegn, Bultosa, Desse Haki, & Rupasinghe, 2015),
		Chloroform leaf extracts	Anti bacterial activities	(Bekele et al., 2015)
		Essential oils extracted from aerial parts	Antifungal and antibacterial	(Nasir, Tafess, & Abate, 2015)
		Aqueous extract of leaf	Antihypertensive and diuretic	(Haji, Makonnen, Debella, & Geleta, 2016)

33.	*Zingiberofcinale* Roscoe	Ethanol (96%) rhizomes extracts	Anti-inflammatory, analgesic and hypoglycaemic	(Ojewole, 2006)
		Methanol extract	Antioxidant and antimicrobial potentials	(Yusuf et al., 2018)
		Gingerols, shogaols, and paradols,	Antioxidant, anti-inflammatory, antimicrobial, anticancer, neuroprotective, cardiovascular protective, respiratory protective, antiobesity, antidiabetic, antinausea, and antiemetic	(Mao, Xu, Cao, & Gan, 2019)

Table 3: Anti-SARS-CoV-2 and other pharmacological activities of some potential phytochemicals and their plant sources

Phytochemical name	Plant source	Pharmacological and biological properties	References
5,7,3′,4′-Tetrahydroxy-2'-(3,3-dimethylallyl) isoflavone	Mojave indigo bush *(Psorothamnus arborescens)*	Antileishmanial, antitrypanosomal and cytotoxic	(Salem & Werbovetz, 2006)
Myricitrin	Wax myrtle (*Myrica cerifera*)	Antioxidant, antiviral, antimicrobial, cytotoxicity anticarcinogenic, and antinociceptive Anti-inflammatory	(W. Chen et al., 2013) (Winekenstädde et al., 2015)
Methyl rosmarinate	Marubio oscuro (*Hyptis atrorubens Poit)*	Antibacteria Antiviral	(Abedini et al., 2013) (Muhammad, Shamshad, Nazakat Hussain, & Zhiyong, 2020)
3,5,7,3′,4′,5′-hexahydroxy flavanone-3-O-beta-D-glucopyranoside	Common bean (*Phaseolus vulgaris*)	Antiviral	(Khazeei Tabari, Khoshhal, Tafazoli, Khandan, & Bagheri, 2020; Tahir ul Qamar, Alqahtani, Alamri, & Chen, 2020)
(2S)-Eriodictyol 7-O-(6″-O-galloyl)-beta-D-glucopyranoside	Indian gooseberry (*Phyllanthus emblica*)	Antidiabetic, antioxidant, anti-inflammatory, antiviral antidiarrheal and antibacterial and antiplasmodic	(Mehmood, Rehman, Rehman, & Gilani, 2013)

Calceolarioside B	Chinese flowering ash (*Fraxinus sieboldiana*)	Ant-iinflammatory and antioxidative	(Lin et al., 2008)
Myricetin 3-O-beta-D-glucopyranoside	Tea tree (*Camellia sinensis*)	Antimicrobial, antioxidant, anticancer, anti-asthmatic, antivirus, antidiabetic and lowers blood sugar	(Sharangi, 2009)
Licoleafol	Chinese liquorice (*Glycyrrhiza uralensis*)	Antiulcer, antiviral, antioxidant, antibacterial, antifungal, antimalarial, antihepatotoxic, antispasmodic, and anti-inflammatory	(Zhou & Wan, 2015)
Amaranthin	Edible amaranth (*Amaranthus tricolor*)	Antiviral, anti-tumor effect, anti-ulcer, antioxidant and anti-inflammatory	(Nahar et al., 2018)
Ochnaflavone	*Lonicera japonica*	Anti-inflammatory and Anticancer	(Makhafola, Samuel, Elgorashi, & Eloff, 2012)
Hispaglabridin B	*Glycyrrhiza glabra*	Antioxidant	(Chin et al., 2007)
Corylin	Psoraleae corylifolia	antioxidant, anticancer, anti-inflammatory and antimicrobial	(Hung et al., 2017)
Licoflavone B	*Glycyrrhiza inflata*	*In vitro schistosomicidal* activity against adult worms of *Schistosoma mansoni*	(Aleixo de Carvalho et al., 2015)
Neoandrographolide	Andrographis paniculata	Anti-inflammatory Superoxide Scavenging	*(J. Liu, Wang, & Ji, 2007)* (Kamdem, Sang, & Ho, 2002)

Discussion

In the present paper, botanical and ethno-botanical features together with their mode of preparation of 33 medicinal plants from the Eastern Hararghe of Ethiopia were reviewed, as indicated in Table 1 above. Here, the plant species listed above are generally classified into different plant families, in which Fabaceae, Asteraceae, Lamiaceae and Sapindaceae are the dominant one. Of the families, Fabaceaeen compasses highest number of antiviral plant species (18.18%) followed by Asteraceae (9.09%), Lamiaceae (9.09%) and Sapindaceae (9.09%). And this is in agreement with documents reported elsewhere in terms of the medicinal status of various families; in which plenty of medicinal plant species exhibiting various pharmacological and biological activities (Table 2) including antiviral are mostly from the family, Fabaceae (Demie et al., 2018). Thus far, there are some hopeful studies which have revealed that medicinal plants which have already been confirmed for their different activity may also have a possibility of curing the corona virus pandemic. According to (Yirga, 2010) for example, some alkaloids and terpenoids isolated from African plants and are known for their antiviral, antimicrobial, antimalarial, antifungal and antileishmanial properties may also inhibit the severe acute respiratory syndrome corona virus 2 (SARS-CoV- 2). Furthermore, from the listed medicinal plants (Table 1), *Azadirachta indica*, *Nigella sativa* L. (black cumin) and rhizomes of *Zingiber officinale* Roscoe (ginger) have been reported as home remedies used medicinal plants used to inhibits several types of viruses in South Indian and Pakistan (Azam, Jahan, & Rahmatullah, 2020; Divya, Vijayakumar, Chen, Vaseeharan, & Durán-Lara, 2020).

A recently published paper also said that some patients with COVID-19 showed improvement when treated with the known antimalarial drug, hydroxychloroquine (Wang, Zeng, Zhao, Chen, & Chen, 2020). Besides, research conducted by (Tarik, 2020)suggested that patients arrested with COVID-19 showed similar clinical characteristics with those who were infected with influenza viruses in which fever, cough, shortness of breath, nasal tampons, fatigue, headaches and expectoration are common symptoms-in onset of illness. From the above- mentioned facts we understand that the medicinal plants reviewed in the present paper may have a potential of defending the corona virus disease 19 (COVID-19). This is because most of the listed plant species (Table 1) have been used by the local community of Eastern Hararghe, Ethiopia to alleviate various diseases (such as flu, cold, cough, respiratory problems, etc.) and other viral

infections which exhibit similar symptoms with that of COVID-19. In addition, our argument is supported by (Tsegyie & Mohammed, 2020)who claimed that traditional Ethiopian medicinal plants and herbal medicines have a potential to cure different viral infections.

In general, as we speak, the world is in a great race in which scholars and other stakeholders are endeavoring day and night to save the life of millions from the rapidly surging corona-virus disease 2019 (COVID-19). Here, in the present review paper, we have triedour best to contribute a little by introducing some possible anti-corona virus disease 19 (COVID-19) medicinal plants found in the Eastern Hararghe, Ethiopia. And in this review, we have made an attempt to look for some potential phytochemicals which have already been claimed as competent candidates against SARS-CoV-2 (Table 3). These compounds listed in Table 3, have showed promising inhibitory effects on non-structural proteins 9 (NSP9) replicate, one of the 16 NSPs of SARS-CoV-2 which play a vital role during the replication and transcription stage of the virus (Bandyopadhyay et al., 2020). Besides, NSP9 including Receptor Binding Domain (RBD)(Dong et al., 2020), spike protein (S), nucleocapsid (N) (Grunewald, Fehr, Athmer, & Perlman, 2018), RNA-dependent RNA polymerase (RdRp) and 3-chymotrypsin-like protease (3Clpro) have been identified as good drug targets for drug research and development against COVID-19. It is therefore highly believed that the phyto-compounds, mentioned in Table 3 together with their botanical sources and other pharmacological properties, might have been considered as starting entities for anti- COVID-19 drug design and development.

Conclusion

Since time unknown, human kind is always in a great warfare with the known and newly emerging opportunistic diseases including viral infections. Corona virus disease 19 (COVID-19) is now one of the continual rivals of humankind in which it is currently surging rapidly globally. Even though tremendous attempts are being made by scholars and pharmaceutical companies to get vaccines and/or drugs against the corona virus pandemic, no hope is found thus far according to the WHO report. Medicinal plant assisted traditional medicine is the first choice as a first aid to minimize the risk of the pandemic. In this paper, we have tried to review the botanical and ethno-botanical features of 33 antiviral medicinal plants found in the Eastern Hararghe region of Ethiopia using some searching databases such as Science Direct, Web of Science, Scopus,

Google Scholar, BioMed Central (BMC) and Springer. With respect to family classification, the highest number of plant species is from Fabaceae (18.18%) followed by Asteraceae (9.09%), Lamiaceae (9.09%) and Sapindaceae (9.09%). The impression of plant based medicine constitutes an applicable way for the expansion of vaccines with attractive features. Seeing as noteworthy add up to plant extracts have capitulate positive outcomes it seems reasonable potential antiviral agents so far reported. The pharmacological characteristic of major south Indian medicinal plants further needs to investigate the exploration of producing vaccines to treat several viral diseases. Reviewed plant species have traditionally been applied for various therapeutic uses by the local society to alleviate infections such as headache, cough, fever, malaria, throat infection, sore throat, headache, diarrhea, influenza and other viral infections. Mentioned infections resemble the COVID-19 in terms of clinical symptoms. We, therefore, strongly believe that the reviewed traditional plant species may have potentials to control or reduce the severity of corona virus pandemic. It is very important these plant based concern not only focused on vaccines and medicines but also the plant based coated clinical equipments like masks, soap and sanitizers etc., The plant based sources has may have the ability to kill the viral based diseases so far, hence it is proven that variety of plant compounds yet to be examined for future invention for the control of COVID-19 like deadly diseases. The unknown fact and formulae about the effectiveness of some plants may be there, therefore medicinal plant and its compound may have the ability to fight against 19-nCoV. By taking this clue into consideration the plant species discussed in the present paper may have been used to fight against COVID-19 either in the form of dose dependent formulation or as sources of new vaccines and/or drugs. Hence, this review may serve as the primary platform for further *in-vitro* and *in-vivo* biological studies to formulate the optimum dose and search possible anti-virus (including COVID-19) vaccines and drugs.

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