Bulletin of Pure and Applied Sciences.
Vol.39 B (Botany), No.2.
July-December 2020: P.106-121
Review Article

Print version ISSN 0970 4612
Online version ISSN 2320 3196
DOI: 10.5958/2320-3196.2020.00016.6
Available online at www.bpasjournals.com

Preliminary Survey of Poisonous, Useful and Medicinal Bee Plants in Ethiopia: Review

[1]Ahmed Hassen*, [2]Meseret Muche

Author's Affiliation
[1,2]Department of Biology, Faculty of Natural and Computational Sciences, Woldia University, Woldia, Ethiopia

***Corresponding Author:**
Ahmed Hassen
Department of Biology,
Faculty of Natural and Computational Sciences,
Woldia University, Woldia, Ethiopia
E-mail:
ah4674763@gmail.com

Received on 15.03.2020
Accepted on 23.07.2020

Keywords:
Honey bee plants,
Nectar,
Poisonous plants,
Pollen,
Toxic

Abstract

Introduction: Ethiopia is one of the world's hotspot areas in biodiversity including poisonous, useful and medicinal higher honey bee plants. However, some are poisonous and lethal to honey bees and humans. This attracts attentions across the globe. There are major gaps in knowledge of exploring local poisonous, useful and medicinal honey bee flora of the country.

Aim: The main purpose of this review was so survey of poisonous, medicinal and useful honey bee plant species, document the most common poisonous plant species to Ethiopia and the world; and then to reach on conclusion in comparison of different authors findings.

Methods: Various studies from different electronic data bases(Google scholar, Science direct, PubMed, Scopus) and from repositories were searched and assessed on the poisonous, useful and medicinal honey bee plants of Ethiopia.

Discussion: Flowering plants provide nectar and pollen or both for bees. However, some species are poisonous to honey bees. Sixty nine poisonous honey bee plant species belonging to 33 families were found as result. Highest number of species were recorded in Ericaceae (7) followed by Solanaceae (6) and Fabaceae (6). Ranunculaceae and Solonaceae represented with 5 species each. Most of them exist as exotic (37) whilst 26 of them were nativespecies. *Datura stramonium, corynocarpus laevigata, piptadenia stipulate, Echium plantagineum, Erythrina fusca, Thevetia peruviana etc.* are invasive species while *Euphorbia heterophylla, Lupinus perennis, Lupin albus* L, *Brugmansia aurea, Euphorbia cotinifolia, Nerium oleander, Delphinium elatumand Asclepias syriaca* L are mainly planted for Ornamental purposes. And also, few of them are Invasive and parasitic plants (*Lathraea clandestine* where it parasites the root of various plants especially legumes, Cuscuta species like *Cuscuta abyssinica* A. Rich, *C. australis and C. acuta*etc.

In **Conclusion**, Future studies that look into the simultaneous impacts of poisonous, useful and medicinal bee plants on bee keeping activity would more accurately illuminate our understanding of the underlying relationships.

INTRODUCTION

Honey bee flora diversity of Ethiopia

Ethiopia is the fifth largest floral country in tropical Africa that earns attention across the globe. This is due to its plant diversity with an estimated number between 6,500 and 7,000 higher plant species (Teklu Gbretsadik, 2016). To Surprise, 60% of these plants are indigenous to the country (Balcha Abera, 2003). Endemic plants from this number account an incredible proportion (Edwards Sue, 1976) and about 1500 species were identified as honeybee forage sources (Edwards Sue, 1976; Fichtl and Addi, 1994). From 1500 species, 500 were identified and published at national level (Fichtland Addi, 1994).

Honey bees are the primary and critical pollinators in the ecology for the conservation of honey bee plant diversity (Fichtl, and Addi, 1994; Plants.ces.ncsu.edu., 2019).Honey bee plants develop colorful flower, wholesome sweet and pleasant to attract pollinators. On the other hand, a number of plant species are reported to their poisonous to honeybees and humans that causedseries health problems (Schulz-Langner, 1966; Lewis, 1998; McGovern, 1999; Mark Ekpri, 2018).Thus, adequate knowledge about honeybee flora is important for beekeeping. Though, there have been some attempts in exploring poisonous and medicinal bee plants of the country, there was as yet no in depth survey was done till now. Hence, identifying the availability of major honeybee forage species is critical for bee keepers to choice economically important and keep away their colony from poisonous plant species.

Honey bee varieties and honey production potential of Ethiopia

Ethiopia is astonishing country for its diversified flowering plants, varied seasons and agro-climatic conditions together created enormous number of bee colonies in the country (Dawit Abebe, 1986;Balcha Abera, 2003;Arnold, 2014).It is estimated as it has over ten million bee colonies with over 6million hives (Arthur YAU, 2013; Ayalew, 1990; USAID, 2012) which made it the fourth largest country in the world following India, China and Turkey (Ayalew, 1990; Schulz-Langner, 1966).It has a capacity of 500,000 tons honey harvesting annually (Central Statistics Authority, 2015; EIAR, 2017); the ninth in the world and first in Africa honey producer (Tesfaye et al., 2017). It is also the third in in the world and first bee wax producer in Africa (MoARD, 2003).It only produces 53,675 tons of honey. This shows that the country is producing less than 10% of its potential (Central Statistics Authority, 2015).

Five common bee varieties are found in different ecological zone of the country. These are: *Apis mellifera jemenitica, Apis mellifera adansanii, Apis mellifera monticola*, *Apis mellifera litorea* and *Apis mellifera abyssinica (*Amsalu, 2004).

Poisonous honey bee plants

Honey bees rely on flowering plants pollen and nectar or both to feed themselves and their larvae as food sources (Admassu *et al*., 2014).In fact, all honey bee plants are not equally important for a variety of bee species in their life and honey production (Nuru, 1996) because nectar from certain flowers is toxic and the resulting honey can cause series health problems.Indeed, thismay be harmless to certain bee species and their larvae (Fichtl and Addi, 1994). A lot of research findings have documented the presence of deterrent or toxic compounds in pollen and nectarto confront honey bees as defense, even kill pollinators (Adler, 2000; Cristina *et al*., 2004; Mesquita *et al*., 2010; Junior *et al*., 2012; Stangaciu, 2015-16). Some of these poisonous honey bee plants are described as follow.

Well known plant families that make poisonous honey from their toxic pollen and nectar are found in Ericaeae, Ranuculaceae, Euphorbiaceae, Solanaceae, Plantaginaceae and Acanthaceae (Edwards Sue, 1976). All parts of *Convallaria majalis*, Brugmansia species, Alstroemeria species, *Lantana camara, Zantedeschia aethiopica*, *Lamprocapnos spectabilis*, and *Aconitum napellus* are highly toxic to humans and honey bees (Plants.ces.ncsu.edu., 2019). The most frequent toxic honey bee plants in many research findings includes *Rhododendron luteum, R. ponticum, R. flavum, Datura stramonium, Kemla latifolia, Aconitum napellus, Aconitum anthora, Nerium oleander, Gelsemium sempervirens, Pieris japonica* and

Zygadenus cenesosus (Ekpri, 2018). As a result of harmful toxic honey from Rhododendrons species are responsible for producing the world's first recorded chemical weapons known (Stevenson *et al*., 2016) and best known natural toxin (Grayanotoxin) that kill honey bees(Jansen *et al*.,2012; Arthur YAU, 2013). Perilous compounds such as alkaloids and phenolics are plenty in nectar of different plant species (Baker, 1977). Grayanotoxin and Diterpenoids chemicals from *Rhododendron ponticum* pollen and nectar lead to rapid mortality in *Apis mellifera*, behavioral effect in *Andrena carantonica* (Sanna, 1931; Tiedeken *et al., 2014*; Tiedeken *et al*., 2016).These studies also strengthen by (Stephenson,2014) as natural toxins in nectar and pollen can poison insects and affect their memory, behaviour and reproductive success. Toxins in bumble bees causes to produce fewer offspring while chemicals found in Rhododendron nectar are toxic to honeybees but not bumble bees, toxic effects that could be contributing to the worrying decline in pollinator species.

Poison from Rhododendron is known as 'Mad honey poisoning' which shows excess salivation and perspiration, weakness, dizziness and numbing of libs will develop after consumption (Arthur YAU, 2013). Thus, honey produced from the pollen and nectar of Ericaeae family is toxic to humans (Treza, 2011; Skinner, 2019; Stevenson,2016) and lead to paralysis if taken in excess or can slowly kill (Ekpri,2018).

Aconitum species (such as *Aconitum napellus*, *A. septentrionale, A. anthora etc.*) are commonly known as Queen of poisons (Chisholm, 1911). They contain the most potent plant toxins, acotitine (Warrell and Eddleston, 2013) and defensive alkaloids in their pollen (Gosselin, 2013). This precarious compound is a fatal poison to most animals (Kevan and Ebert, 2005).Honey from its pollen and nectar is known tocauses cardiotoxic and neurotoxic tohumans (Jaeger, 1961). All parts of Aconitum plants are also reported as toxic even though toxicity decreases from the root tip towards the flower (Brent Furbee, 2009).

Frequent research findings revealed that *Kalmia latifolia* (Palmer-Jones & Line, 1962; Pryce-Joxes,1944), *Solanum nigram (*Palmer-Jones & Line, 1962*), Verartrum californicu* (Vansell and Watkins, 1933; Eckert, 1946; Mussen, 1979), *Helenium autumnale* (Pryce-Joxes, 1944), *Zygadenus cenesosus (*Eckert, 1946; Mussen, 1979),*Corynocarpus laevigata* (Palmer-Jones & Line (1962), *Angelica triqueta (*Bell, 1971), *Ochrama lagopus* (Paula,1997) and species from the genus of *Cuscuta (*Palmer-Jones & Line, 1962),*Sophora (*Clinch, 1972), Tilia (Crane,1977) *and Asclepias (*Eckert, 1946; Mussen, 1979)are toxic to honey bees.In addition to these, *Euphorbia cotinifolia* (Getachew, 2012),*Croton macrostachyus, Piptadenia stipulacea (*Mesquita *et al*., 2010*), Euphorbia geniculate* (Deodikar, 1959) *and* Tutu plant (Arthur YAU, 2013; Fuentealba *et al*., 2007) are regarded as toxic to honeybees. Direct snipping of the flower nectar or consuming its honey caused humans paralyzed and dead in *Gelsemium sempervirens* (Skinner, 2019), vomiting and diarrhea in *Justicia schimperiana* (Tesfaye, 2014; Nuru, 1996).

The brood and adult bees can be poisoned from the pollen and nectar of *Aesculus californica* (Eckert, 1946; Palmer-]ones *et al*., 1947; Levinson, 1976) and *Astragalus lentiginosus* (Grout, 1949; Vansell, and Watkins, 1933; Mussen, 1979; Majak *et al*.,1980) that caused to the losses of the colonies from its range (Skinner, 2019).This is due to its highly toxic ingredients (Deodikar *et al*., 1958) as the same as the nectar of yellow jasmine have reduced pollen receipt and lethal effect on the brood and queen bees (Adler, 2000; Manson and Thomson, 2009; Manson *et al*., 2012; Otterstatter *et al*., 2010; Pryce-Joxes, 1944). In fact, nectar from *Cyrilla racemiflora* cause purple brood (Skinner, 2019) and highly poisonous to adult bees only in *Corynocarpus laevigata* tree (Palmer-Jones *et al*., 1947; Palmer-Jones & Line, 1962).

A lot of plant species as such *Spathodea capanulata,Ranunculus multifidus* (Harugade *et al*.,2016), *Ochroma lagopus* (Palmer-]ones *et al*.,1947), *Amygdalus communis* (Kevan and Ebert, 2005) and *Lasiosiphon eriocephalus* (Chaubal, & Deodikar,1963) produce pollen or nectar or both which can adversely affect honey bees. This is also common to cases killing the adults (such as Toxicoscordio), creating a problem only when passed to the brood.

The presence of chancy toxic chemicals in *Camellia thea* (Sharma *et al.*, 1986), *Tilia platyphyllos (*Butler, 1943), *Asclepias syriaca* and *Asclepias albicans* (Pryces-Jones, 1942) causes paralysis and deaths to bees and their larvae. Honey from *Lasiosiphon eriocephalus* pollen adversely cause severe nausea and

vomiting (Chaubal, & Deodikar, 1963) and irritates when eaten in *Brugmansia arborea* (Getachew, 2012).Honey from *Senecio vernalis, Lupaninus mutabilis* and *S. eupatorium* pollen and nectar known to causes the mortality of honey bees and insects (Arthur YAU, 2013; Hartmann, 1999; Arnold, 2014).

Pollen from all Ranunculus, Echium and Asteraceae species contain metabolites for defense mechanisms that result high mortality rates for pollinators (Bergstrom et al., 1995; Kempf, 2010). Higher concentration alkaloidin Nicotiana nectar reduces larval survival of honeybees (Kessler & Baldwin,2008; Singaravelan *et al*., 2005; Kohler *et al*., 2012; Human *et al*., 2014: Richardson *et al*., 2015) as same as Echium pollen (Trunz *et al*., 2017) which isrepellent and toxic to several types of insects (Detzel,1993; Levinson, 1976). *Azadirachta indica* is used as a pesticide and insect repellent (Karunamoorthi *et al*, 2009; Mesquita *et al*., 2010) and Pollen ofit is allergenic to humans (Boral, 2004). Unlike the nectar, these chemicals in the pollen of *Prunus amygdalus* are repellent to different bee species (Singaravelan *et al*., 2006; Wright *et al*., 2010; Tiedeken *et al*., 2014).

An extraordinary concentration of purine alkaloid in the nectar of Citrus species is repellent to honeybees (Singaravelan *et al*., 2005; Mustard *et al*., 2012; Wright *et al*., 2013; Couvillon *et al*., 2015; Thomson *et al*., 2015) and is pesticide that prevents insect feeding (Nathanson, 1984) as the same as in Dipsacusspecies (Faizal and Geelen, 2013). This is alsotrue in *Lupinus perennis and L.albus*, Phalaenopsis, Delphinium species *(e.g. Delphinium elatum*), Sinningia species (Emrich, 1991, Kordan *et al*., 2012). To Surprise, All species of the genus Delphinium are toxic to humans and livestock (Wiese, 2013) that can cause severe digestive discomfort (Olsen *et al.,* 1990; Wiese, 2013). It also can causes death through cardiotoxic and neuro-muscular blocking effects (Smith, 2002).

According to (Thomson *et al*., 2015), honey from poisonous plants has detrimental effect on honeybees and human beings. This can be from *macrostachyus*, *Sobralia violacea, Sobralia rosea,* and *Justiciaschimperiana* (Cingel, 2001; Pij and Dodson, 1966).

Pollen and nectar from *Toxicoscordion paniculatum* had a neurotoxic alkaloid (Can, 2018). Most parts of *Ricinus communis,* oleander species (Bandara *et al*., 2010) and *Convallaria majalis (*Lewis, 1998; Nelson *et al*., 2007) are potentially poisonous. *Pieris japonica* is poisonous if consumed by people or animal (Smith, 1978) there is neurotoxin in its petals, leaves and pollen. It can cause painful burning in the mouth whenever eaten and could lead to seizures, temporary blindness or even a coma (Robinson, 2015).

Medicinal honey bee plants

Bees collect essential pollen and nectar from flowering plants to feed themselves and their larvae (Haydak, 1970). Honey obtained from honey bee plants has been used to treat various human aliments and wounds in ancient Indian, Chinese, Romans, Greeks, Arabs and Egyptians (McGovern, 1999).

A number of research studies indicate thathoney has antimicrobial effects. This includes anti-bacterial, antiviral, anti-ulcer activities, anti-inflammatory, antihyperlipidemic, antidiabetic and anticancer properties (Erejuwa *et al*., 2010; Viuda-Martos *et al*., 2008).The colony life as whole and its products such as wax and honey depend on the abundance and diversity of plants in the ecology (Schmidt *et al*., 1987). In other way, honey from variety of flowers seemsto play an important role in immunity (Alaux, 2013). Some of the important medicinal honey bee plants in Ethiopia are below.

Rosmarinus officinalis is widely used as antiseptic agent, treat relaxing problems with menstruation, stress and digestive related problems. *Sanguinaria Canadensis* is also highly accepted for their medicinal properties even if its toxic properties to humans (Croaker *et al*., 2016). A lot of studies revealed that *Lantana camara'*s leaves, stems and flowers are used to treat influenza, cough, mumps, persistent high fever, malaria, TB, Dermantitis and Rheumatism. This is the same in *Datura stramonium,* whichis mainly used against asthmatic breathing troubles, heart problems, worms, tooth ache, fever, and mental disorder and famous in homeopathy if taken in small amount. Moreover, *Nerium oleander* isan important plantthat can act as immune-stimulating power, against cancer, hepatitis and psoriasis (Stangaciu, 2015-16).

Table1: List of Common defensive and poisonoushoney bee plants in Ethiopia

No	Scientific name of the plant	Common name	Family	Status	SP	References for its poisonous
1	*Aconitum anthora*	Queen of poison	Ranuculaceae	Exotic	MN	Brent Furbee, 2009; Chisholm, 1911; Warrell and Eddleston, 2013
2	*Aconitum napellus*	Monks hood	Ranuculaceae	Not found	MN	Chisholm, 1911; Furbee, 2009; Ameri,1998; Warrell and Eddleston, 2013
3	*Aconitum septentrionale*	Northern variant	Ranunculaceae	Exotic	MN	Furbee, 2009; Chisholm, 1911; Warrell and Eddleston, 2013
4	*Aesculus californica**	California Buckeye	Sapindaceae	No evidence	PN	Eckert, 1946; Palmer-]ones *et al*., 1947; Skinner, 2019; Deodikar *et al*.,1958
5	*Aesculus hippocastaneum@* Saponin*	Horse chest nut	Sapindaceae	No evidence	PN	Schulz-Langner, 1966
6	*Amygdalus communis L.*	Almond	Rosaceae	Ind.	PN	Kevan and Ebert, 2005
7	*Angelica triqueta**	Mountain angelica	Apiaceae	Exotic	PN	Bell, 1971
8	*Arbutus unedo@* arbutin (glycoside)	----------	Ericaceae	Ind.	PN	Pryces-Jones, 1942
9	*Asclepias syriaca L.** Galitoxin	Milkweed	Apocynaceae	Ind.	PN	Pryces-Jones, 1942; Mussen, 1979; Eckert, 1946
10	*Astragalus lentiginosus**	Milk vetech	Fabaceae	Exotic	PN	Mussen, 1979; Eckert,1946; Majak *et al*.,1980
11	*Atropa belladonna@* Alkaloids	----------	Solanaceae	Ind.	PN	Detzel and Wink ,1993
12	*Azadirachta indica*	Neem plant	Meliaceae	Exotic	PN	Mesquita *et al*.,2010
13	*Bersama abyssinica*	Winged bersama	Melianthaceae	Ind.	PN	Bekele,2007
14	*Brugmansia arborea*	Angel's trumpets	Solonaceae	Exotic	PN	Getachew *et al.,* 2012
15	*Brugmansia aurea*	Golden angels trumpet	Solonaceae	Exotic	PN	Detzel and Wink, 1993
16	*Camellia thea**	Tea tree	Theaceae	Exotic	PN	Sharma *et al*., 1986
17	*Campanula rapunculoides@* Alkaloids	----------	Campanulaceae	Ind.	PN	Baker and Baker, 1975

18	*Convallaria majalis*	Lily of the valley	Asparagaceae	Exotic	PN	Lewis, 1998; Ellenhorn *et al*., 2004; Nelson *et al*, 2007
19	*Corynocarpus laevigata**	karaka tree	Corynocarpaceae	Ind., invasive	PN	Palmer-Jones & Line, 1962; Levinson, 1976
20	*Croton macrostachyus*	Broad-leaved croton	Euphorbiaceae	Ind.	PN	Getachew, 2012; Chisholm, 1911
21	*Cucurbita pepo*@ Alkaloids	Summer squash	Cucurbitaceae	Ind.	PN	Baker and Baker, 1975
22	*Cuscuta abyssinica* A.Rich	Scald weed	Convolulaceae	Ind.	PN	Palmer-Jones & Line, 1962
23	*Cuscuta salina*@ Alkaloids	----------	Convolvulaceae	Ind.	PN	Baker and Baker, 1975
24	*Cyrilla racemiflora*	Leather wood	Cyrilliceae	No evidence	N	Mussen, 1979; Eckert, 1946
25	*Datura stramonium*	Jimson weed, thorn apple	Solonaceae	Exotic, Invasive	PN	Ekpri, 2018
26	*Delphinium elatum*	Candle Larkspur	Ranunculaceae	Exotic	PN	Wiese,2013; Smith,2002
27	*Dipsacus fullonum L.*	Teasel	Caprifoliaceae	Ind., invasive	PN	Faizal and Geelen, 2013
28	*Echium plantagineum*@ Pyrrolizidine alkaloid	Paterson's curse	Boraginaceae	Exotic a, Invasive	PN	Culvenor *et al*, 1981
29	*Ehretia cymosa*	----------	Boraginaceae	Ind.	PN	Bekele, 2007
30	*Erythrina fusca*	Coral bean	Fabaceae	Exotic, Invasive	PN	Feinsinger and Swarm, 1978
31	*Eupatorium cannabinum*	Hemp Agrimony	Asteraceae	Exotic	PN	Hartmann, 1999; Mesquita *et al*., 2010; Karunamoorthi *et al*., 2009
32	*Eupatorium purpureum*	Gravel root	Asteraceae	Exotic	PN	Pryces-Jones,1942;Hartmann,1999;Karunamoorthi *et al*.,2009; Mesquita *et al*.,2010
33	*Euphorbia cotinifolia**	Smoke tree spurge	Euphorbiaceae	Exotic	PN	Getachew, 2012; Pryces-Jones, 1942
34	*Euphorbia geniculate**	Wild poinsettia	Euphorbiaceae	Exotic	PN	Pryces-Jones, 1942; Chisholm, 1911
35	*Gelsemium sempervirens**	Yellow Jessamine	Loganiaceae	Ind.	PN	Eckert,1946; Pryce-Joxes, 1944

36	*Helenium autumnale*	Sneezeweed	Asteraceae	Ind.	PN	Pryce-Joxes, 1944
37	*Justicia shimperiana*	----------	Acanthaceae	Ind., invasive	PN	Chisholm, 1911; Nuru, 1996; Tesfaye, 2014
38	*Kalmia latifolia*&*	Mountain Laurel	Ericaceae	Exotic	PN	Mussen, 1979; Eckert, 1946; Tesfaye, 2014
39	*Lasiosiphon eriocephalus*	----------	Thymelacaeaceae	No evidence	N	Chaubal & Deodikar, 1963
40	*Lathraea clandestine@* ammonia; high p	Purple toothwort	Orchidaceae	Exotic, Invasive	PN	Ellenhorn *et al*., 2004
41	*Ledum palustre@& glycoside*	----------	Ericaceae	Ind.	PN	Emrich ,1991
42	*Liriodendron tulipiferum@ Non protein amino acids*	----------	Magnoliaceae	Ind.	PN	Baker and Baker, 1975
43	*Lupaninus mutabilis*	Lubin bean	Fabaceae	Exotic	PN	Arnold *et al*., 2014
44	*Lupinus perennis L.*	Lubin	Fabaceae	Exotic	PN	Emrich, 1991; Kordan *et al*. ,2012
45	*Mimulus moschatus@ alkaloid*	----------	Scrophulariaceae	Ind.	PN	Baker and Baker, 1975
46	*Nerium Oleander*	Pink oleander	Apocynaceae	Exotic& Invasive	PN	Ekpri, 2018
47	*Nicotiana tabacum@ Alkaloid*	Common tobacco	Solonaceae	Exotic	PN	Detzel and Wink, 1993
48	*Ochroma lagopus**	Balsa tree	Malvaceae	Exotic	PN	Palmer-Jones *et al*., 1947; Paula *et al*., 1997
49	*Paullina australis&*	----------	Sapindaceae	Exotic	PN	Jaeger, 1961
50	*Pieris japonica&*	Japanese Andromeda	Ericaceae	Ind.	PN	Smith,1978; Bekele, 2007; Robinson, 2015
51	*Piptadenia stipulacea*	Piptadenia	Fabaceae	Exotic, Invasive	PN	Mesquita *et al*.,2010
52	*Prunus amygdalus*	Almond tree	Rosaceae	Exotic	PN	Wright *et al.,* 2010; Tiedeken *et al*., 2014; Singaravelan *et al*., 2005
53	*Ranunculus multifidus*	Africa butter cup	Ranunculaceae	Ind.	PN	Getahun et al., 1976; Bergstrom *et al.*,1995; Ameri, 1998; Kempf et al., 2010
54	*Rhododendron flavum* &*	Azalea pontica	Ericaeae	Exotic	PN	Jaeger, 1961; Jansen *et al*., 2012
55	*Rhododendron luteum**	Azalea pontica	Ericaeae	Exotic	PN	Jaeger,1961; Jansen *et al*., 2012

56	*Rhododendron ponticum*@& Alkaloids	Rhododendron	Ericaeae	Exotic, Invasive	PN	Wright *et al*.,2010; Jaeger, 1961; Jansen *et al*., 2012; Tiedeken *et al*., 2016; Treza, 2011; Baker andBaker, 1975; Skinner, 2019
57	*Ricinus communis*	Costar bean	Euphorbiaceae	Ind.	PN	Bandara *et a*., 2010
58	*Senecio vernali*	Eastern groundsel	Asteraceae	No evidence	PN	Renhard *et al.,* 2009
59	*Sinningia incarnate*	----------	Gesneriaceae	Ind.	N	Emrich,1991
60	*Sobralia violacea*	Sobralia	Orchidaceae	Ind., Invasive	PN	Leendert *et al*.,1966; Cingel ,2001
61	*Solanum nigram**	Black night shade	Solonaceae	Ind., invasive	PN	Eckert, 1946; Mussen, 1979
62	*Sophora microphylla**	Weeping Kowhai	Fabaceae	Exotic	PN	Clinch *et al*., 1972
63	*Spathodea campanulata*	African tulip tree	Bignoniaceae	Exotic	PN	Palmer-Jones *et al*., 1947
64	*Thevetia peruviana*	Yellow oleander	Apocynaceae	Exotic, Invasive	N	Ekpri M, 2018;Bandara *et al*., 2010
65	*Tilia platyphyllas**	Large leaved lime	Tiliaceae	Exotic	PN	Butler,1943
66	*Toxicoscordion paniculatum*	Foothill death camas	Melanthiaceae	Exotic	PN	Cane, 2018
67	*Verartrum californicum**	Corn lily	Liliaceae	Ind.	PN	Eckert, 1946; Mussen, 1979; Vansell and Watkins, 1933
68	*Zantedeschia aethiopica*	Lily of the Nile	Araceae	Ind.	PN	Plants.ces.ncsu.edu., 2019
69	*Zygadenus cenesosus**	Meadow death camas	Melanthiaceae	Exotic	PN	Eckert, 1946; Mussen, 1979

Key: Plants with known secondary metabolite compounds against bees (@), Poisonous plants to bees (*), poisonous honey bee plants to humans (&), Indigenous (Ind.), Both pollen and nectar (PN), Mainly nectar source (MN), Source of Poison (SP)

According to Croaker *et al*. (2016), the pollen, nectar and sap of honeydew of *Abies alba*, *Castanea sativa*, *Aesculus hippocastanum*, *Fagus silvatica, Fraxinus excelsior, Betula alba, Acer platanoides, Viscum alba, Sophoro japonica, Tilia platyphylla, Tilia tomentosa, Tilia cordata, Salix alba, Prunus amygdalus, Prunus spinosa, Citruslemon* and *Verbena officinalis* are medicinal honey bee plants.

Furthermore, *Dhatoda vasica, Lantana camera, Sesamum indicum, Vitex negundo and Tridax procumbens* are important honey floral species. *Azadirachta indica*, *Citrus limon* Linn and *Citrus aurantifolia* L. are recommended as medicinal honey bee plants (Harugade *et al*, 2016). Lemon Balm is definitely a favorite of the bees. The leaves are antibacterial, anti-inflammatory, antioxidant, antiviral, sedative and aromatic properties and used to treat many conditions (Barczewski, 2015).

METHODS

Data on the topic were gathered from journals, published books, and different electronic databases. We searched ample databases to identify and get appropriate studies published in Web of Science, ProQuest, Google Scholar, PubMed, Science Direct, Scopus, Medline plus, and others using titles related to WEPs in Ethiopia. We removed gray literature of unpublished, duplicated articles and that did not go ahead with our title. We screened full text of articles that were eligible for locally available poisonous, use full and medicinal honey bee plant species in Ethiopia. The data obtained were explained with descriptive way.

DISCUSSION

Diversity of poisonous Plants

Varied agro-climatic zones and seasons of Ethiopia created a diversified honey bee plant ecology that makes it among the principal honey producers in Africa. It is obvious as honey bees usually visit variety of flowers including poisonous plant species. Hence, for better bee colony life, reproduction and assured nutrition for human health, there must have sufficient supply of both nectar and pollen from useful and medicinal honey bee plants. This in turn needs to keep away the hive colony from poisonous plant species when in bloom.

Fifty nine poisonous honey bee plant species cited by different authors are laid down to 33 families.Most of the species were belongs to Ericaceae (7), Solanaceae (6) and Fabaceae (6). Ranunculaceae and Solonaceae represented with 5 species each.

Acanthaceae, Apiaceae, Araceae, Asparagaceae, Campanulaceae, Caprifoliaceae, Corynocarpaceae, Cucurbitaceae, Cyrilliceae, Gesneriaceae, Liliaceae, Loganiaceae, Magnoliaceae, Malvaceae, Melanthiaceae, Meliaceae, Melianthaceae, Scrophulariaceae, Theaceae, Thymelacaeaceae and Tiliaceae were recorded with one species each.

Most of them exist as exotic (37), Native (26), no evidence for their availability (5) and one species not found at all in the country. *Erythrina fusca, Thevetia peruviana etc.* are invasive species while others are widely cultivated as food and ornamental plants in some high lands of Ethiopia (*Lupinus perennis* and *L.albus* L.).

Euphorbia heterophylla, Lupinus perennis, Lupin albus L, *Brugmansia aurea, Euphorbia cotinifolia, Nerium oleander, Delphinium elatumand Asclepias syriaca* L are mainly cultivated here in our country as an Ornamental plant around Hotels, Botanical gardens, Campus, Houses and road sides. Few of them are Invasive and parasitic plants (*Lathraea clandestine* where it parasites the root of various plants especially legumes, Cuscuta species like *Cuscuta abyssinica* A. Rich, *Cuscuta australis and Cuscuta acuta* Engelm. etc.

*Datura stramonium (*Deodikar *etal.*, 1958; Chisholm, 1911; Edwards Sue, 1976), *Croton macrostachyus* (Chisholm, 1911), Bog Rosemary, Nerium Oleander (Ekpri, 2018), *Arbutus unendo (*Sanna, 1931), *Azadirachta indica* (Karunamoorthi *et al*., 2009), *Lantana camara (*Ekpri, 2018), and *Tilia platyphyllas* (Boral *et al*.,2004) are categorized as poisonous honey bee plants. *Citrus* speciesnectar at high

concentration is known toxic to bees (Nathans, 1984; Mustard *et al*., 2012; Wright *et al*., 2013). However, other studies indicate that *Datura stramonium,Tilia platyphyllos, Nerium oleander* and *Lantana camara etc.* had medicinal activity in small amount. The strawberry tree and lime tree species (Harugade, 2016; Croaker, 2016) are observed as medicinal honey bee plants too.

CONCLUSIONS AND FUTURE PERSPECTIVE

Conclusion

A large body of research findings demonstrates the negative impacts of poisonous bee plants on the bee colony, wax production and human nutrition sector. The nutritional content of honey bee plants pollen and nectar is important to conserve recommended medicinal honey bee plants. To increase efficacy in bee colony conservation, healthy honey production, enhance their diversity and abundances, it is a must to explore the local poisonous, useful and medicinal honey bee plants in Ethiopia. In the same way, the impact of nutritional status as a cumulative process across several regions of the country should be done.

This review article thus emphasizes on the preliminary survey of poisonous, useful and medicinal bee plants in Ethiopia. This endeavored to bring it into a single manuscript by compressing all research findings across the globe and Ethiopia as much as possible. This in turn creates awareness to the bee keepers and other stakeholders about their colony health as same as in getting assured food nutrition from honey in their day to day diet.

Future perspectives

Researchers should be motivated to carry in depth experimental based nutritional analysis on the impact of poisonous and medicinal bee plants to the health of bee species and humans as well. This review article will also enhance researchers to fill the major gaps in knowledge of exploring local poisonous, useful and medicinal honey bee plants of the country.

There is a need to create awareness to bee keepers at local, regional, federal level and non-Governmental stakeholders on poisonous, use full, and medicinal honey bee plants. Medicinal and use full honey bee plants need to be raised in hedge rows of agriculture areas, buffer zones of forests, road sides etc. Honey bee keepers should grow the recommended Use-full and medicinal honey bee flora around their hives.

REFERENCES

1. Adler LS (2000).The ecological significance of toxic nectar. Oikos 91: 409– 420.
2. Admassu, A., Kibebew, W., Amssalu, B., &Ensermu, K. (2014). Honeybee forages of Ethiopia. Addis Ab
3. Alaux, C. (2013). Influence of pollen nutrition on honey bee health: do pollen quality and diversity matter?
4. Ameri A. (1998). The effects of Aconitum alkaloids on the central nervous system. Progress in Neurobiology 56: 211– 235.
5. Amsalu B (2004). Bee keeping in south and south western Ethiopia. Journal of bees for development, 73:8.
6. Ann Barczewski (2015). Planting Herbs that Attract Honey Bees.
7. Arnold SEJ, Idrovo MEP, Arias LJL, Belmain SR, Stevenson PC. (2014). Herbivore defense compounds occur in pollen and reduce bumblebee colony fitness. Journal of Chemical Ecology 40: 878– 881.
8. Arthur YAU (2013). Food Safety Focus (89th Issue, December 2013); Food Safety Platform. Risk Assessment Section, Centre for Food Safety
9. Ayalew, K. (1990).The honey bees (Apis mellifera) of Ethiopia. Amorphometric study. M.Sc thesis, Agricultural University of Norway.

10. Azene Bekele (2007). Useful trees and shrubs for Ethiopia: Identification, Propagation and Management for 17 Agro-climatic Zones. World Agroforestry Centre, East Africa Region, Nairobi Kenya, 2007.
11. Baker, H. G. (1977). Non-sugar chemical constituents of nectar. Apidologie 8: 349–356.
12. Baker, H.G. and Baker, I (1975). Studies of nectar constitution and pollinator-plant coevolution. In: Gilbert, I.E and Raven, P.H. (eds). Coevolution of plants and animals. Univ. of Texas press, pp.100-140.
13. Balcha Abera (2003). Medicinal plants used in traditional medicine in Jimma Zone, Oromia, southwest Ethiopia. Ethiop. J. Health sci., 13 (2): 85-94.
14. Bandara, V., Weinstein, S., White, J. and Eddleston, M. (2010). A review of the natural history, toxinology, diagnosis and clinical management of Nerium oleander (common oleander) and Thevetia peruviana (yellow oleander) poisoning. Toxicon, 56(3), pp.273-281.
15. Bell, C.R. (1971). Breeding systems and flora biology of the Umbelliferae or evidence for specialization I unspecialized flowers. In: Heywood, V.H. (ed). The biology and chemistry of the umbelliferae. Acadamic press, pp93-107.
16. Belzunces, L.P., Le Conte, Y. (2010). Interactions between Nosema microspores and a neonicotinoid weaken honeybees (Apis mellifera). Environ. Microbiol. 12, 774–782.Endalew Alemu (2007).Use and management of medicinal plants by indigenous peoples of Ejaji area (Chelya Woreda), West Shoa, Ethiopia: An ethnobotanical approach. MSc thesis, AAU, Ethiopia.
17. Bergstrom G, Dobson HEM and Groth I. (1995). Spatial fragrance patterns within the flowers of Ranunculus acris (Ranunculaceae). Plant Systematics and Evolution; 195: 221– 242.
18. Boral B., Chatterjee S. and Bhattacharya K. (2004). The occurrence and allergising of airborne pollen in West Bengal, India. Annals of Agricultural and Environmental Medicine 11(1): 45-52.
19. Brent Furbee (2009). Neurotoxic plants. Clinical neurotoxicology
20. Butler, C. G., (1943).Bee paralysis and May sickness. - Bee World, 24, p. 3.
21. Cane JH. (2018). Co-dependency between a specialist Andrena bee and its death camas host, Toxicoscordion paniculatum. Arthropod-Plant Interactions 12: 657– 662.
22. Carey, F.M., Lewis, J.J., MacGregor, J.L. and Martin Smith, M. (1959). Pharmalogical and chemical observations on some toxic nectar. J. chem. ecol. 20:849-857.
23. Central Statistics Authority, (2015). The Federal Republic of Ethiopia Agricultural Sample Survey. Report on Livestock and Livestock Characteristics. Statist. Bull. 578(II):23. Central Statistics Authority
24. Chaubal, Pushpa D. and Deodikar, G.B. (1963). Pollen Grains of Poisonous Plants, Grana, 4:3, 393-397.
25. Chisholm, Hugh (1911).Aconite". Encyclopedia Britannica.1 (11th ed.). Cambridge University Press.pp.151-152.
26. Cingel, Nelis A. (2001). An atlas of orchid pollination: America, Africa, Asia and Australia. CRC Press. ISBN 978-90-5410-486-5.
27. Clinch, P.G., Palmer-Jones, T. AND Forster, I.W. (1972). Effects on honey bees of nectar from the yellow Kowhai (Sophora microphylla Ait.). N.Z.J.Agric.Res. 15:194-201.
28. Couvillon, M.J., Al Toufailia, H., Butterfield, T.M., Schrell, F., Ratnieks, F.L.W. & Schurch, R. (2015). Caffeinated forage tricks honeybees into increasing foraging and recruitment behaviours. Current Biology, 25, 1– 4.
29. Crane, E. (1977). The world's beekeeping - past and present: Dadant and Sons (ed.), The Hive and the Honey Bee. Dadant and Sons, Inc, Hamilton, Illinois, U.S.A., pp.1-38.
30. Crane, E. (1990). Bees and Beekeeping Science, Prctice and World resources. Heinemann
31. Cristina A, De Carvalho P, Message D. (2004). A scientific note on the toxic pollen of Stryphnodendron polyphyllum (Fabaceae, Mimosoideae) which causes sacbrood-like symptoms. Apidologie 35: 89– 90.
32. Croaker, A., King, G., Pyne, J., Anoopkumar-Dukie, S. and Liu, L. (2016). Sanguinaria canadensis: Traditional Medicine, Phytochemical Composition, Biological Activities and Current Uses. International Journal of Molecular Sciences, 17(9), p.1414
33. Csuvth.colostate.edu. (2019). Guide to Poisonous Plants – College of Veterinary Medicine and Biomedical Sciences – Colorado State University

34. Culvenor, C.C.J., Edgar. J.A. and Smith, L.W. (1981). Pyrrolizidine alkaloids in honey from
35. Dawit Abebe (1986). Traditional medicine in Ethiopia. The attempt being made to promote it for effective and better utilization. SINET: Ethiop. J. Sci., 9: 61-69.
36. Deodikar, G. B., Thakar, C. V., Phadre, R. P. and Shah, P. N. (1958). Poisoning of honey bees foraging on Euphorbia geniculala. - Bee World, 39(5): 118-120.
37. Detzel A and Wink M. (1993). Attraction, deterrence or intoxication of bees (Apis mellifera) by plant allelochemicals. Chemoecology 4: 8– 18.
38. Echium plantaginetum L.-J.Agric. Food Chem. 29:958-960.
39. Eckert, J.E. (1946). Inquiry to bees by poisoning. In: Grout. R.A. (ed.). The hive and the honey bee. Dadant and Sons. pp.570-582.
40. Edwards Sue (1976). Some wild flowering plants of Ethiopia.A ddis Ababa University press, Addis Ababa, Ethiopia.
41. EIAR (2017).Ethiopian Institute of Agricultural Research: Livestock and Fisheries Research: Livestock and Fisheries Research Strategies. Poultry, Fisheries, Apiculture and Sericulture. Addis Ababa, Ethiopia, pp. 153-224.
42. Ekpri M, (2018). Review Plants That Make Honey Poisonous To Humans; Inquisitrl.html.
43. Ellenhorn, M.J., Caravati, E.M., McGuigan, M.A.(2004). Medical toxicology. Lippincott, Williams and Wilkins. p.1703.
44. Emrich BH. (1991). Acquired toxicity of the lupin aphid, Macrosiphum albifrons, and its influence on the aphidophagous predators Cocinella septempunctata, Episyrphus balteatus and Chrysoperla carnea. Z Pflanzenk Pflanzen 98: 398– 404
45. Erejuwa, O., Sulaiman, S., Wahab, M., Sirajudeen, K., Salleh, M.M., Gurtu, S. (2010). Antioxidant protection of Malaysian tualang honey in pancreas of normal and streptozotocin-induced diabetic rats. Ann. Endocrinol., 291-296.
46. Faizal, A. and Geelen, D. (2013). Saponins and their role in Biological processes in plants. Phytochemistry Reviews 12: 877– 893.
47. Feinsinger, P. and Swarm. L.A. (1978). How common are anti-repellant nectars? Biotropica 10:238-239.
48. Fichtl, R. and Addi, Admassu (1994). Honeybee Flora of Ethiopia. Margraf Verlage, Germany
49. Fuentealba J, Guzman L, Manriquez-Navarro P,Perez C, Silva M, Becerra J, Aguayo LG(2007). Inhibitory effects of tutin on glycine receptors in Spinal neurons". European Journal of Pharmacology. 559(1):61-4.
50. Gallai, N., Salles, J., Settele, J. AND Vaissiere, B.E. (2009). Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. Ecol. Econ. 68, 810-821.
51. Getachew A, Yemisrach, Assefa, D, Adgaba, N, Ganga, G and Abebe, W. (2012). Honey production systems (Apis mellifera L.) in Kaffa, Sheka and Bench-Maji zones of Ethiopia. Munich Personal RePEc Archive
52. Gosselin M, Michez D, Vanderplanck M, Roelants D, Glauser G, Rasmont P. (2013). Does Aconitum septentrionale chemically protect floral rewards to the advantage of specialist bumblebees? Ecological Entomology 38: 400– 407.
53. Grout, Rov A. (1949)."The hive and the honey bee." pp. 568-70.Dadant, Hamilton, Illinois. 652 pp.
54. Hartmann T. (1999). Chemical ecology of pyrrolizidine alkaloids. Planta 207: 483– 495.
55. Harugade, S., Gawate, A.B. and Shinde, B. (2016). Bee Floral Diversity of Medicinal Plants in VidyaPratishthan Campus, Baramati, Pune, District (M.S.) India ; International Journal of Current Microbiology and Applied Sciences ,Volume 5 Number 11 (2016) pp. 425-431
56. Haydak, M.H. (1970). Honey bee nutrition. Annu. Rev. Entomol. 15, 143–156
57. Human, H., Archer, C.R., du Rand, E.E., Pirk, C.W. & Nicolson, S.W. (2014).Resistance of developing honeybee larvae during chronic exposure to dietary. Journal of Insect Physiology, 69, 74– 79.
58. Jaeger, P. (1961). The wonderful life of flowers.-E.P. Dutton &Co.
59. Jansen, SA, Kleerekooper, I., Hofman ZL., Kappen IF., Stary-Weinzinger, A. and Vander Heyden MA. (2012). Grayanotoxin Poisoning: Mad Honey Disease' and Beyond. Cardiovascular Toxicology. 12 (3): 208–13.

60. Junior EM de A, Fernandes IM dos S, Santos CS, de Mesquita LX, Pereira RA, Maracajá PB, Soto-Blanco B. (2011).Toxicity of castor bean (Ricinus communis) pollen to honeybees. Agriculture, Ecosystems & Environment 141: 221– 223.
61. Karunamoorthi, K; Mulelam, A and Wassie, F (2009). Assessment of knowledge and usage custom of traditional insect / mosquito repellent plants in Addis Zemen Town, South Gonder, North Western Ethiopia. Journal of Ethnopharmacology 121(1): 49-53.
62. Kassim, M., Achoui, M., Mustafa, M.R., Mohd, M.A., Yusoff, K.M. (2010). Ellagic acid, phenolic acids, and flavonoids in Malaysian honey extracts demonstrate in vitro anti-inflammatory activity. Nutr. Res. 30, 650-659.
63. Kempf M, Heil S, Hablauer I, Schmidt L, von der Ohe K, Theuring C, Reinhard A, Schreier P, Beuerle T. (2010). Pyrrolizidine alkaloids in pollen and pollen products. Molecular Nutrition and Food Research 54: 292– 300.
64. Kessler, D. and Baldwin, I.T. (2008). Field experiments with transformed plants reveal the sense of floral scents. Science, 321, 1200– 1202.
65. Kevan PG. and Ebert T. (2005). Can almond nectar and pollen poison honey bees? American Bee Journal 145: 507– 510.
66. Kishore, R.K., Halim, A.S., Syazana, M.N., Sirajudeen, K. (2011). Tualang honey has higher phenolic content and greater radical scavenging activity compared with other honey sources. Nutr. Res. 31, 322-325.
67. Kohler, A., Pirk, C.W.W. & Nicolson, S.W. (2012) Honeybees and nectar nicotine: deterrence and reduced survival versus potential health benefits. Journal of Insect Physiology, 58, 286– 292.
68. Kordan B, Dancewicz K, Wróblewska A, Gabryś B. (2012). Intraspecific variation in alkaloid profile of four lupine species with implications for the pea aphid probing behaviour. Phytochemistry Letters 5: 71– 77.
69. Kozlova, M. V. (1957). Nectar of Ledum palustre as a possible source of the toxicity of honey. Voprosy Pitaniya 16: 1980.
70. Leendert Van der Pijl; Calaway H. Dodson (1966).Orchid Flowers Their Pollination and Evolution.University of Miami Press. ISBN 978-0-87024-069-0.
71. Levinson HZ. (1976). The defensive role of alkaloids in insects and plants. Cellular and Molecular Life Sciences 32: 408– 411.
72. Lewis, R.A., (1998). Lewis Dictionary of toxicology. CRC press.P.309.
73. Majak W, Neufeld R, Corner J (1980). Toxicity of Astragalus miser V. serotinus to the honeybee. Journal of Apicultural Research 19 (3): 196-199.
74. Manson J.S. and Thomson J.D (2009). Post-ingestive effects of nectar alkaloids depend on dominance status of bumblebees," Ecological Entomology, vol. 34, no. 4, pp. 421–426.
75. Manson, J.S, Rasmann, S., Halitschke, R., Thomson, J.D. & Agrawal, A.A. (2012). Cardenolides in nectar may be more than a consequence of allocation to other plant parts: a phylogenetic study of Asclepias. Functional Ecology, 26, 1100– 1110.
76. Mark Ekpri(2018). Plants That Make Honey Poisonous to Humans. The inquisitor publisher-2008-18.
77. Maurizio A (1975). How bees make honey. pp 96-97 from Honey: a comprehensive survey. ed. E. Crane. London: Heinemann in cooperation with International Bee Research Association.
78. McGovern, D., Abbas, S., Vivian, G., Dalton, H., 1999.Manuka honey against Helicobacter pylori.J. R. Soc. Med. 92, 439.
79. Mesquita LX, Maracajá PB, Sakamoto SM and Soto-Blanco B. (2010). Toxic evaluation in honey bees (Apis mellifera) of pollen from selected plants from the semi-arid region of Brazil. International bee research association; Journal of Apicultural Research 49(3): 265-269.
80. Mitton J. (2018). The paradox of toxic nectar and pollen in death camas Arts and Sciences Magazine. University of Colorado Boulder.html
81. MoARD (2003). Ministry of Agriculture and Rural Development: Honey and Bee wax and marketing plan, Addis Abeba, Ethiopia.
82. Mussen, E.C. (1979). Buckeye poisoning.-U.C. Apiaries Uni. Of California cooperative extension: 1-4.

83. Mustard, J.A., Dews, L., Brugato, A., Dey, K. & Wright, G.A. (2012). Consumption of an acute dose of caffeine reduces acquisition but not memory in the honey bee. Behavioural Brain Research, 232, 217– 224.
84. Nathanson J. (1984). Caffeine and related methylxanthines: possible naturally occurring pesticides. Science 226: 184– 187.
85. Nelson, L.S., Shish, R.D., Black, M.J. (2007). Handbook of poisonous and injurious plants. Springer science and Business media. Pp.133-4.
86. Nuru A. (1996). Poisonous honey source plant (Justicia shimperiana) in Agew Mider area in northwest part of Ethiopia (case study report). Holetta Bee Research Centre, Holetta, Ethiopia
87. Nuru, A., Ahmed, A., Yilma, T., Awraris, G., Awad, M., Mohammad, J., Ayman, A., SeifEldin, A., & Abdulaziz, S. (2017). Nectar secretion dynamics and honey production potentials of some major honey plants in Saudi Arabia. Saudi Journal of Biological Sciences, 24, 180-191.
88. Olsen, J.D., Manners, G.D., Pelletier, S.W. (1990). Poisonous properties of larkspur (Delphinium spp). Collectanea Botanica Barcelona. (19).145-51.
89. Otterstatter MC, Manson JS, Thomson JD. (2010). Consumption of a nectar alkaloid reduces pathogen load in bumble bees. Oecologia 162: 81– 89.
90. Palmer-jones, T.; Sutherland, M. D.; Paterson, C. R.; Harris, W. F. and Filmer, Doris W. (1947). A recent outbreak of honey poisoning. N.Z. J. Sei. Teeh. 29 (Sec. A.): 107-43.
91. Palmer-Jones & L.J.S Line. (1962).P oisoning of honey bees by nectar from the Karaka tree (Corynocarpus laevitigata J.R et G. Forst.). New Zealand journal of agriculture research.5:5-6,433-436.
92. Palmer-Jones (1962).Poisoning of Honey Bees by Nectar from the Karaka Tree.New Zealand Journal of Agricultural Research. Animal Research Station, Department of Agriculture, Wallaceville
93. Pasquale, G., Salignon, M., Le Conte, Y., Belzunces, L.P., Decourtye, A., Kretzschmar, A., Suchail, S., Brunet, J.L.,
94. Pasupuleti Visweswara Ra, Kumara Thevan Krishnan, Naguib Salleh and Siew Hua Gan (2016). Biological and therapeutic effects of honey produced by honey bees and stingless bees: a comparative review. Rev. Bras. farmacogn. vol.26 no.5 Curitiba.
95. Paula, V.F., Barbosa, L.C.A., Demuner, A.J (1997). Entomotoxicity of the nectar from Ochroma lagopus Swartz (Bombacaceae). Ciencia e cultura49:274-277.
96. Plants.ces.ncsu.edu. (2019). Alstroemeria (Lily-of-the-Incas, Peruvian Lily).North Carolina Extension Gardener Plant Toolbox.
97. Plants.ces.ncsu.edu. (2019). Convallaria majalis (Lily of the Valley, Lily-of-the-valley) | North Carolina Extension Gardener Plant Toolbox
98. Plants.ces.ncsu.edu. (2019). Lamprocapnos spectabilis (Bleeding Heart, Japanese Bleeding Heart).North Carolina Extension Gardener Plant Toolbox.
99. Plants.ces.ncsu.edu. (2019). Zantedeschia (Calla Lily). North Carolina Extension Gardener Plant Toolbox.
100. Pryce-Joxes, J., (1944). Some problems associated with nectar, pollen and honey. - Proc. Linn. SOC. Lond., Session 1012-43, 155(II): 129-174.
101. Pryces-Jones, J. (1942). Some problems associated with nectar, pollen and honey.-proc linn.Soc.Lond.155:129-174.
102. Prys-Jones, O.E. and Willmer, P.G. (1992). The biology of alkaline nectar in the purple toothwort (Lathraea clandestina): ground level defences. Biol. J. Linn. Soc. 45: 373–388.
103. Reinhard, A., Janke, M., von der Ohe, W., Kempf, M., Theuring, C. and Hartmann, T. (2009). Feeding deterrence and detrimental effects of pyrrolizidine alkaloids fed to honey bees (Apis mellifera). Journal of Chemical Ecology, 35, 1086– 1095.
104. Richardson LL, Adler LS, Leonard AS, Henry K, Anthony WE, Manson JS and Irwin RE. (2015). Secondary metabolites in floral nectar reduce parasite infections in bumble bees. Proceedings of the Royal Society B: Biological Sciences 282: 20142471.
105. Robinson, G. (2015). Pieris japonicas stay away deer-2015.
106. Sanna, A., (1931). On a property of honey from Calluna having bitter taste. - Ann. chim. appl., 30 (p. 397).

107. Schmidt, J.O., Thoenes, S.C. and Levin, M.D. (1987). Survival of honey bees, Apis mellifera (Hymenoptera: Apidae), fed various pollen sources. J. Econ. Entomol. 80, 176–183
108. Schulz-Langner, E. (1966). Quantitative Nachweis Kleinster Saponinmengendurchbeachten der Hamolysedauer. P lanta Medica 14:49-56.
109. Sharma OP, Raj D and Garg R. (1986). Toxicity of nectar of tea (Camellia Thea L.) to honeybees. Journal of Apicultural Research 25 (2): 106-108.
110. Singaravelan, N., Inbar, M., Ne'eman, G., Distl, M., Wink, M. andIzhaki, I. (2006). The effects of nectar-nicotine on colony fitness of caged honeybees. Journal of Chemical Ecology, 32, 49–58.
111. Singaravelan, N., Ne'eman, G., Inbar, M. andIzhaki, I. (2005). Feeding responses of free-flying honeybees to secondary compounds mimicking floral nectars. Journal of Chemical Ecology, 31, 2791– 2804.
112. Skinner J. (2019). Bee health, poisonous nectar. New Technologies for Agriculture Extension grant no. 2015-41595-24254 from the USDA National Institute of Food and Agriculture.
113. Smith, Bradford (2002).Large animal internal medicine (3rd ed.). St. Lousis Mosby.p.252.
114. Smith, M.C. (1978). Japanese pieris poisoning in the goat. Journal of the America Veternary medical association. 173 (1).78-79.
115. Stefan Stangaciu (2015-16). List of 122 medicinal bee plants; Apitherapy, Matamba nectar-Brauschweig/Germany, p203.
116. Stephenson, P.C (2014). Toxic nectar affects the behavior of insect pollinators. Science daily; British Ecological Society.
117. Stevenson, Philip C., Wright, Geraldine A. and Nicolson, Susan W. (2016). Plant secondary metabolites in nectar: impacts on pollinators and ecological functions. British Ecological Society.
118. Teklu Gbretsadik (2016). Causes for Biodiversity Loss in Ethiopia: A Review from Conservation Perspective. South Agricultural Research Institute (SARI), Hawassa Agricultural Research center. Vol.6, No.11, 2016 United Printers.
119. Tesfaye B, Genet D and Temaro G. (2017). Assessment of honey bee enemies in Bale zone, south eastern Ethiopia .Journal of Agricultural extension and rural development, 9(4):53-61.
120. Tesfaye, H (2014). Honey bee diseases, Pest and their economic importance in Ethiopia. International journal of innovation and scientific research Vol. 10 No. 2 pp. 527-535.
121. Thomson, J.D., Draguleasa, M.A. and Tan, M.G. (2015). Flowers with caffeinated nectar receive more pollination. Arthropod-Plant. Interactions, 9, 1– 7.
122. Tiedeken E.J., Egan, P.A., Stevenson, P.C., Wright, G.A., Brown, M.J.F., Power, E.F., Farrell. I., Matthews, S.M. and Stout, J.C. (2016). Nectar chemistry modulates the impact of invasive plant species on native pollinators. Functional Ecology.
123. Tiedeken E.J., Stout J.C., Stevenson P.C. & Wright G.A. (2014). Bumblebees are not deterred by ecologically relevant concentrations of nectar toxins. Journal of Experimental Biology 217: 1620-1625.
124. Treza, R. (2011). "Hallucinogen honey hunters". Top documentary films.com. Retrieved 20 October 2015.
125. Trunz V, Luchetti M, Bénon D, Kast C, Glauser G and Praz CJ. (2017). Chemical ecology and the complex nature of bee-flower relationships in the family Boraginaceae. In: Phylogenetics as a tool for evolutionary studies: evolution of the leafcutter bees and chemical ecology of bee-flower relationships. PhD thesis, University of Neuchatel, Switzerland, pp. 65– 99.
126. United States Agency for International Development-USAID (2012). Agricultural Growth Program-Agribusiness and Market Development (AGP-AMDe) Project. Submitted by ACDI/VOCA to Contracting Officer's Representative Tewodros Yeshiwork, USAID Ethiopia
127. Vansell, G. H. and Watkins, W. G., (1933). A plant poisonous to bees. - J. Econ. Entomol., 26 (p. 168). - 1934: Adult bees found dying on spotted loco weeds. - J. econ. Entornol. 27 (p. 635).
128. Viuda-Martos, M., Ruiz-Navajas, Y., Fernández-López, J. and Pérez-Álvarez, J., (2008). Functional properties of honey, propolis, and royal jelly. J. Food Sci. 73, R117-R124.
129. Warrell, David A and Eddleston, Michael (2013). Poisonous plants and aquatic animals. Hunters' Tropical medicine and emerging infectious Diseaes (Ninth).

130. Wiese, Karren (2013). Sierra Nevoda wild flowers. A field guide to common wild flowers and shrubs of the Sierra Nevada including Yosemite, Sequia and kings canyon national parks(2nd ed.).Falcon Guides .p.52.
131. Wright G.A., Baker D.D., Palmer M.J., Stabler D., Mustard J.A., Power E.F., Borland A.M. & Stevenson P.C. (2013). Caffeine in floral nectar enhances a pollinator's memory of reward. Science 339: 1202-1204.
132. Wright, G.A., Mustard, J.A., Simcock, N.K., Ross-Taylor, A.A.R., McNicholas, L.D., Popescu, A. (2010). Parallel reinforcement pathways for conditioned food aversions in the honeybee. Current Biology, 20, 2234– 2240.
133. Getahun A, Tewolde B.G. E, Mesfin T. (1976). A study of the medicinal plants of Ethiopia – Part 1 A- The identity of some of the plants. The faculty of Science, Department of Biology, Addis Ababa