Documentation of Ethnomedicinal Uses of Wild Plants Growing in Kodo Mountain by Kurdish Tribe of Iraq

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(Received on 4th May 2023, accepted in revised form 8th November 2023)

Summary: Medicinal plants have a long history of different uses and are still of great importance in the daily life of the Kurds living in the Kurdistan province of Iraq. The present review provides comprehensive phytochemical and pharmacological information about medicinal plants growing in the Kodo Mountain area. In fact, no systematic study of the bioresources from this unique region has yet been reported in the scientific literature, even if local villagers have been consuming several plants as nutrition and ethnomedical food for centuries, until today.

The data reported in this paper were obtained through interviews with local herbal healers and people living in villages around the Kodo Mountains. They concern 40 plants belonging to 16 botanical families, which are considered medicinal by the local population. The present study recorded and examined the demographic information given by the study participants, the local names and the parts used of the plants, the preparation and administration techniques, and the treatments for diseases. The most frequently cited families were Asteraceae (32.5 %), Lamiaceae (10 %), Brassicaceae, Malvaceae, and Papaveraceae (7.5 % each). The main parts of the plants used for medicinal purposes were leaves (36 %) and flowers (29.5 %). They were administered as decoctions (42 %), raw (26 %), or powder (14 %). Several important phytochemicals have been isolated from the used plants, including flavonoids (60 %), terpenoids (45 %), phenolic acids (42.5 %), polyphenolic compounds (40 %), and essential oils (30 %). The plant ethnomedicinal and pharmacological uses were supported by their antibacterial (18%, Apiaceae, Lamiaceae, Papaveraceae), anti-inflammatory (18%, Malvaceae, Asteraceae, Papaveraceae), anti-oxidant (16%, Malvaceae, Apiaceae, Lamiaceae, Asteraceae, Papaveraceae), anti-cancer (9%, Lamiaceae, Papaveraceae, Asteraceae), anti-parasitic (8%, Asteraceae), hepatoprotective (7%, Asteraceae, Lamiaceae, Papaveraceae, Fabaceae), anti-diabetic (5%, Asteraceae, Fabaceae), anti-fungal (5%, Amaryllidaceae, Umbelliferae, Asphodelaceae, Orchidaceae), anti-spasmodic (4%, Asteraceae, Papaveraceae), and diuretic (3%, Asteraceae, Amaryllidaceae, Plantaginaceae) activities. This study illustrates the significance of traditional medicinal plants that have been utilized for treatment and healing the wounds and curing the illnesses Kurdish tribe in Kodo mountain, north-east part of Kurdistan Region in Iraq, that can be used as reference for further investigations for the researchers in future.

Keywords: Kodo Mountain, Phytochemistry, Ethnopharmacology, Medicinal plants, Metabolites.

Introduction

Ethnobotany can be defined as the study of the relationship between people and plants. The term "ethnobotany" was coined in 1896 by the American botanist John Harshberger (*1*) to describe the study of plants used by the peoples living in a particular area, considering the cultural and the ecological contexts in which they are. For the entire history of humanity, especially medicinal plants have been used extensively worldwide to treat a wide range of disorders and maladies and have had a significant role in international trade. Peoples have learnt how to use medicinal herbs by trial and error, and knowledge has usually been passed from one generation to another only orally. The geographical location of the Iraqi Kurdistan Region, and the geological and ecological

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features make the region's biodiversity one of the richest in Iraq *(2).*

The Kodo Mountain is located about 103 km north-east of Erbil, capital of the Kurdistan Region (Fig 1). The flora and the ethnobotany of the Kodo Mountain region have not yet been fully investigated. Therefore, we started this work with the aim of raising awareness of the region's botanical resources that need to be valued and protected. In particular, we focused on the possible relationship between traditional applications and medicinal effects, and we evaluated the therapeutic potential of the region's natural remedies. Moreover, the information given in this study adds to the limited number of scientific studies recently conducted about the structures and bioactivities of metabolites isolated from medicinal plants native to regions near the Kodo Mountain (*2-12*).

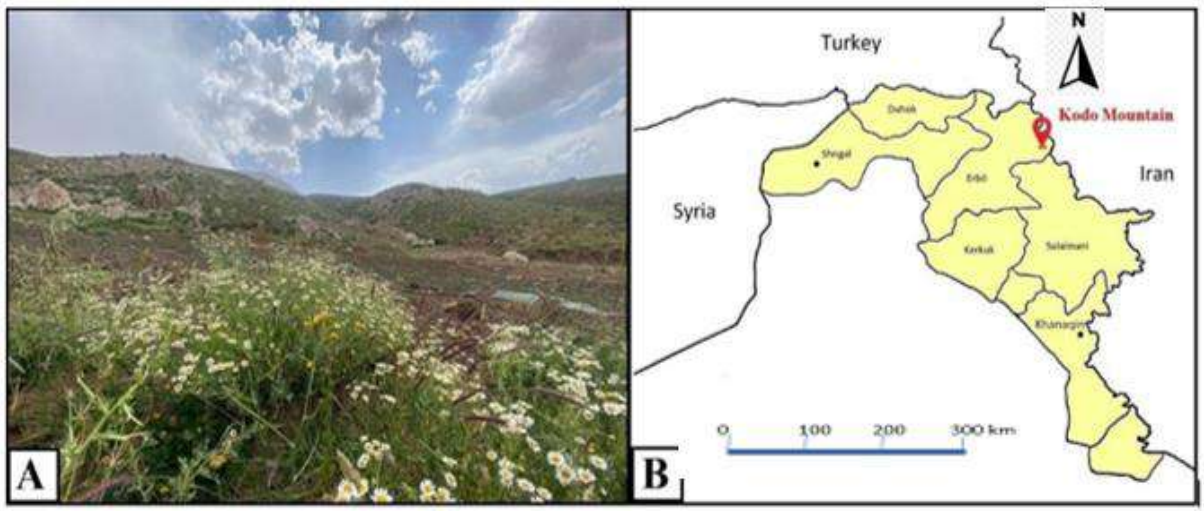

Fig 1: A. Kodo Mountain, Kurdistan region, Erbil–Iraq. B. Map of Kurdistan Region–Iraq.

Fig. 2: Interviews with local people living around the Kodo Mountain areas.

Plant Material

A total of 40 medicinal plants (Table 1) were mentioned by local people in the interviews. Samples of the plants (Fig 3) were collected and identified by Prof. Abdul-Hassan Al-Khayat at Salahaddin University and are deposited at Applied Science Faculty Herbarium, Tishk International University, Erbil, Kurdistan Region of Iraq.

The families of Asteraceae, Lamiaceae, Apiaceae, Malvaceae, and Papaveraceae included the greatest number of plants, making the 65% of the cited species (Fig 4).

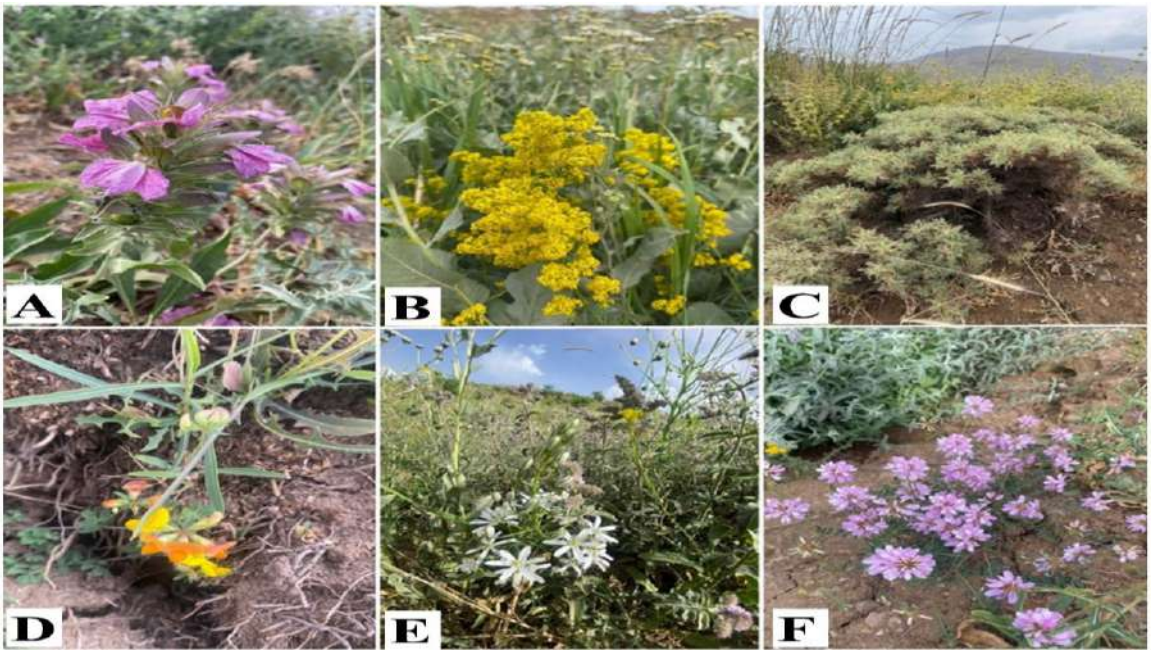

Fig 3: Some Plants Growing in the Kodo Mountain Area, A: *Dactylorhiza umbrosa, B: Achillea ageratum, C: Artemisia absinthium, D: Astragalus glaucacathus, E: Asphodelus albus, F: Cichorium intybus.*

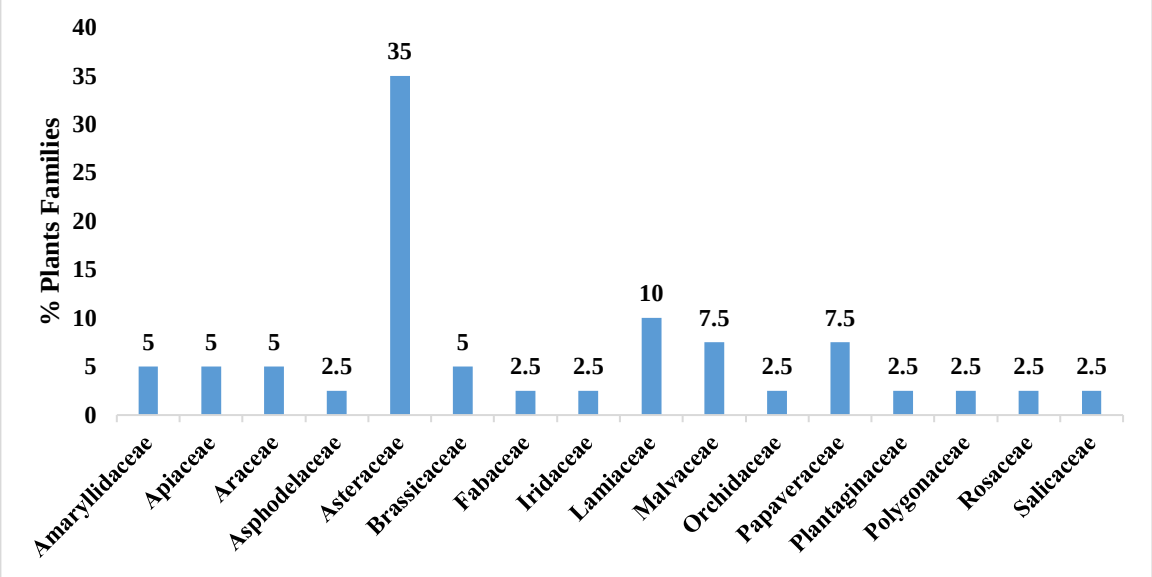

Fig 4: Percent distribution of the botanical families of plants collected on the Kodo Mountain.

Phytochemical Aspects

A search in the scientific literature revealed that more than 150 compounds were isolated and identified from the plants listed in Table 1. Flavonoids (60%) were the compounds most isolated from the plants, followed by terpenoids (45%) and phenolic acids (42.5%). Other compounds which were also present in significant amounts are polyphenolic derivatives (40%), essential oils (30%), alkaloids (27.5%), carbohydrates (27.5%), steroids (25%) and fatty acids (20%), while the remaining compounds occurred in minor amounts (Fig 5).

The plants were most consumed as decoction (42%) or as raw (26%). Less frequently, they were consumed as a powder (14%), an infusion (8%), a chew?? (4%), a gum, a juice, and by smoking (2% each)

The most used parts of plants were leaves (36%) and flowers (29.5%), followed by roots (8%), seeds and stems (6% each), fruits and bulbs (each 5% each), aerial parts (3%), and latex (1.5%).

Biological and Pharmacological Aspects

Over the whole history of human life plants have supplied food, various types of flavors, medications, garments, and protection means worldwide. Nowadays, the study of outstanding medicinal properties and application of plants native to different regions is one of the most active research fields. The great biodiversity of plants growing on the slopes of the Kodo Mountain and the lack of a systematic scientific knowledge prompted us to conduct a comprehensive study (Table 1). Indeed, the interviews with the people living in this rural area demonstrated that almost all native plants have some applications; above all, they are used as traditional remedies to treat most diseases, except acute and urgent cases that require a surgery. Anti-inflammatory, antibacterial, anticancer, cardioprotective, antioxidant, and antiparasitic effects are the properties most frequently attributed to the plants growing in the Kodo Mountain (Fig 6). Each group of plants displays a characteristic range of biological activities, as shown in Fig 7 for the families containing the highest numbers of species. The families of Asteraceae and Papavareaceae exhibited the widest spectra of pharmacological effects, while Malvaceae showed only two types of biological properties. Within the Asteraceae, *Achillea ageratum*, *A. millefolium*, and *A. santolina* are examples of plants widely used by local herbalist, which exhibited many beneficial effects (Table 1).

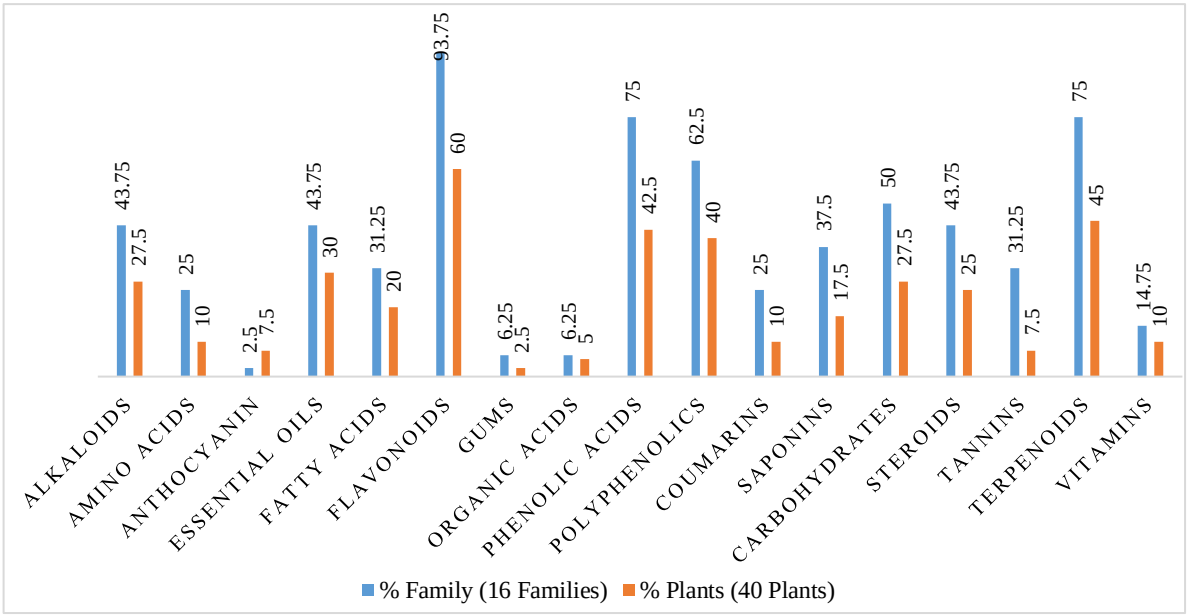

Fig. 5: Percentages of the most abundant natural products isolated from the investigated plants and families.

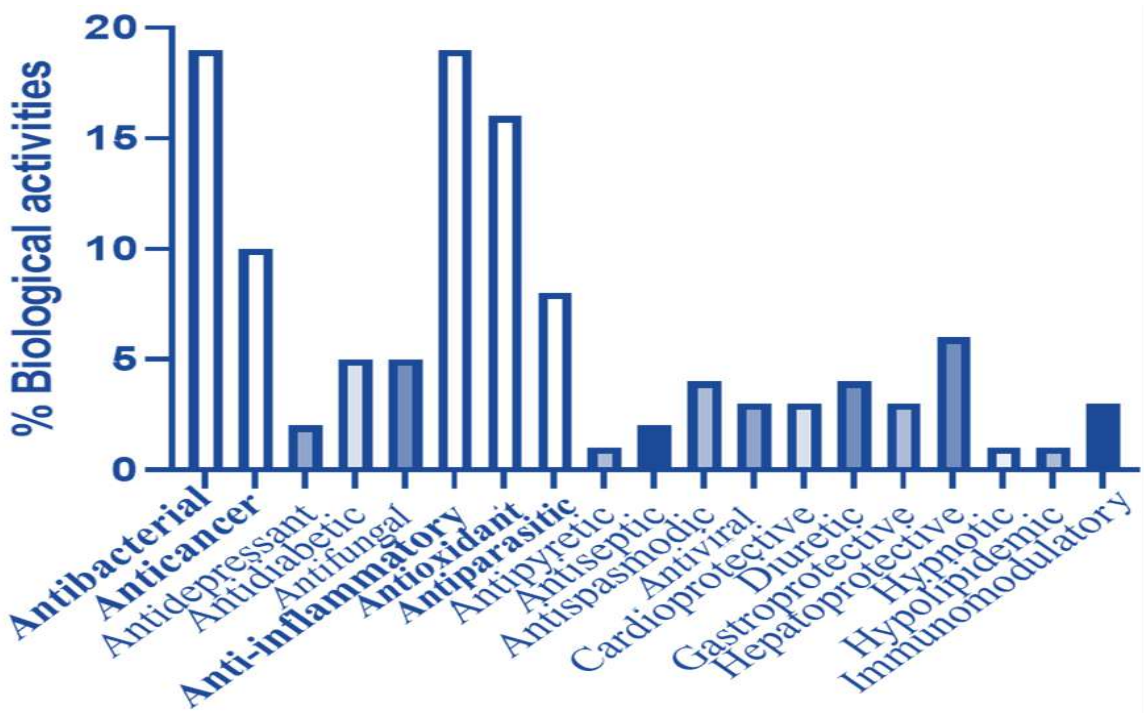

Fig. 6: Percentages of biological activities attributed to plants collected in the Kodo Mountain.

Thus, *Achillea ageratum* has showed antioxidant, cytotoxic, antibacterial, and anti-inflammatory properties. On the other hand, antispasmodic, anticancer, hepatoprotective, antidiabetic, and antileishmanial activities have been determined for the flower and leaf extracts of *A. millefolium* and *A. santolina*. *Anthemis des champs* (*A. arvensis*), *Artemisia absinthium, Cota tinctoria*, *Echinops viscosus nozaff* are other species in the Asteraceae family that possess remarkable pharmacological effects (Table 1).

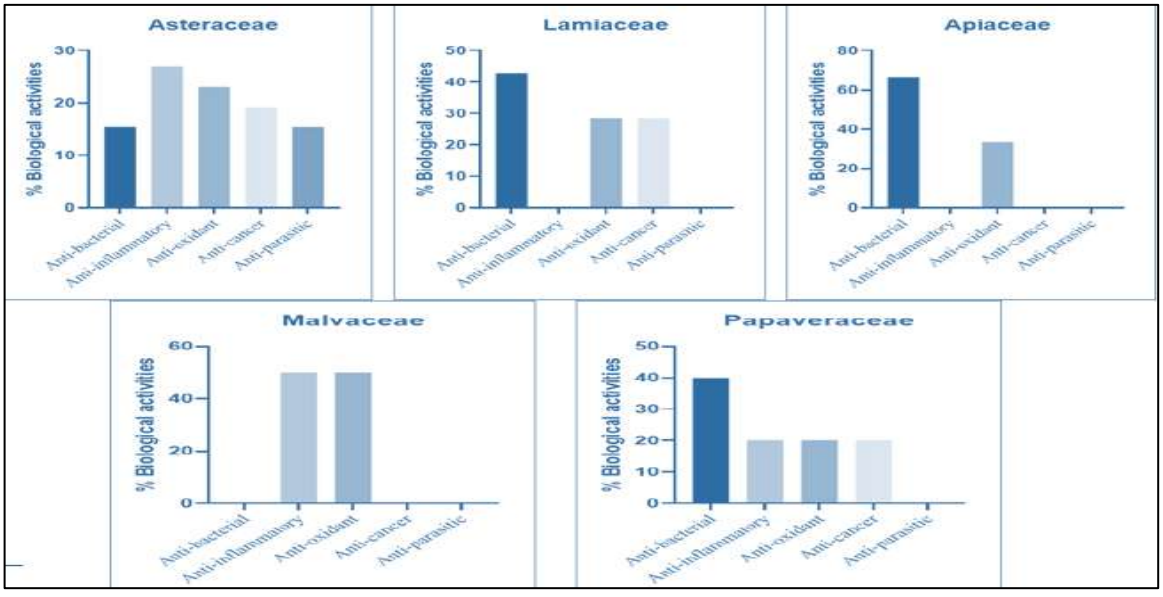

Fig **7:** Percentages of various biological activities determined for the five families containing the highest number of species.

Table-1: Literature data concerning medicinal plants growing in Kodo Mountain.

S.No	Scientific name (Family)	Common names (Kurdish) English	Part used/ preparations	Traditional uses, to cure	Phytochemicals	Pharmacological effects
1	*Achillea ageratum* Linn. (Asteraceae)	(bejana zard) sweet maudlin	leaves, flowers	asthma, cough, diarrhea	fatty acids, phenolic acids, organic acids, phytosterols, flavonoids, terpenes including guaianolides (*14, 15*)	antibacterial, antioxidant, anti-inflammatory, cytotoxic effects (*16*)
2	*A. millefolium* Linn. (Asteraceae)	(bejan) yarrow	leaves, flowers / powder, boiling (Internal what means??)	bleeding, cold, ulcer, fever, to cure gynecological disorders	phytosterols, organic acids, phenolic acids, fatty acids, terpenes, including guaianolides, flavonoids (*15, 17*)	antispasmodic, hepatoprotective, (*18*)
3	*A. santolina* Linn. (Asteraceae)	(gulla beron)	Leaves, Flowers/ Fresh gum, Boiling (Internal)	gastrointestinal tract problems stomach diseases, ulcer	diterpenes, monoterpenes, sesquiterpenes, including sesquiterpene lactones, triterpenes, Flavonoids, Lignans, Essential oils (*19*)	antileishmanial, anticancer, antidiabetic (*20*)
4	*Alcea angulate* Freyn. (Malvaceae)	(gulle hiro) mallow	Flowers, Roots/ Boiling (internal)	Cold, Cough	Amino acids, Acidic polysaccharides, Flavonoids, Monosaccharides, pectinic acid, Syringic acid, p-Coumaric acid, Ferulic acid, p-Hydroxybenzoic acid, Caffeic acid, p-Hydroxyphenylacetic acid, Glucuronic acids, Rhamnose, and Galacturonic acid (*21, 22*)	hypolipidemic, cardioprotective, antimalarial (*23*)
5	*Allium ampeloprasum* Linn. (Amaryllidaceae)	(qurada) wild leek	Leaves, Bulbs/ Eaten	Antihypertensive	Irigenin, Sterebin A, Gerberinol, Rosmarinic acid, *ent*-epiafzelechin-(2α-7,4α-8)-catechin, Myristicanol B, Ramontoside, Urodiolenone, *trans*-Carvyl acetate, Epiafzelechin-(aα-8)-pelargonidin-3'-glucoside, Boviquinone 4, Dihydrofukonolide, 2-(2-methylbutanoyl)-9-(3-methyl-2*E*-pentenoyl)-2b,9a-dihydroxy4*Z*,10(14)-oplopadien-3-one, 6-Acetylfuranofukinol, Erinacine D, *N*-□-glutamyl-*S*-*cis*-(1-propenyl) cysteine, *N*-□-glutamyl-*S*-allyl cysteine, Terpenoids (*24, 25*)	
6	*Althaea officinalis* Linn. (Malvaceae)	(hero) marsh mallow	Flower/ Tea, Boiling	Cough	Alkaloids, Tannins, Triterpenes, Amino acids, Phenolic acids, Starch, Pectins, Asparagine, Coumarins, Phytosterols, Flavonoids, Mucilage (*26-28*)	Gastroprotective, antioxidant (*29*).
7	*Ammi visnaga* Linn. (Apiaceae)	(xalila) pick tooth	Seeds/ Boiling (Internal)	Vasodilator, Bronchodilator	Essential oils, Fatty acids, Flavonol, Flavonoids, Sterols, Phenols, Coumarins, γ-Pyrones, Visnagin and Khellin (*30-34*); Ammiol, Khellol, Khellinol, Visamminol, 4-Norvisamminol (*35*). Pimolin (III), 5,7-Dihydroxy-2-methyl-γ-pyrone-7-*O*-glucoside (*36*); *cis*-Khellactone-3'-β-D-glucopyranoside (*37*); Visnadin (*38*), Khellinin, Khellinone, Samidin, Dihydrosamidin, Visanginone (*34*); Ammoidin, Xanthotoxin, Psoralene, Bergapten (*39, 40*)	antioxidant, antifungal, antibacterial, and larvicidal (*40*).
8	*Anthemis des champs (Anthemis arvensis* Linn.*)* (Asteraceae)	(beibun) chamomile	Flowers/ (External, Internal)	Indigestion, Skin Whitening, Shortness of Breath, Diabetes	Essential oils, Polyphenolics, Glycosides, Quinic acid, Caffeic acid, Flavonoids including Quercetin and Apigenin-7-glucoside, α-Eudesmol, γ-Cadinene, γ-Cadinol, β-Pinene, Patuletin, Rosmarinic acid, Decanoic acid, Gentisic acid, Chlorogenic acid, 1,8-Cineole, T-Muurolol, , α-Bisabolol, α-Bisabolene, Bisabolol oxide A,	antibacterial and anticancer (*44*)

					β-Farnesene, Chamazulene, α-Epicadinol, (+) Spathulenol, Germacrene D, Heptacosane, γ-Elemene, Caryophyllene oxide, Hexadecanoic acid ethyl ester, 9,12-Octadecadienoic acid (*41-43*)	
9	*Artemisia absinthium* Mill. (Asteraceae)	(tolleke marane) wormwood absinthe	Flower/ Decoction	Shortness of Breath, Diabetes	Essential oil, Thujyl esters, α-Thujone (*45*)	
10	*Arum maculatum* Fisch. (Araceae)	(kardu) lord and ladies	Leaves/ Boiling (Internal)	Gastrointestinal tract diseases	Phytol, Palmitic acid, Methyl linolenate, 9,12,15-Octadecatrienoate ester and Linolenate ester (*37*); Seventeen Chemicals have been isolated including Terpenes, Carbonyl Derivatives, Alcoholic compounds, Thiols, Fatty acid esters (*38*). More than 40 metabolites have been identified including aliphatic and aromatic compounds, mono-, sesquiterpenoids, nitrogen bearing compounds, and C5 branched chain components (*39*)	antioxidant, antimicrobial; toxic to humans (*46*)
11	*Asphodelus albus* Mill. (Asphodelaceae)	(astrelk) white asphodel	Roots/ Powder	Anti-Dermatosis	Furan-3-ylmethyl ester and Essential oils (*47*).	
12	*Astragalus glaucacathus* Fisch. (Fabaceae)	(gueni) astragale	Leaves, Roots/ Smoking (External)	Antiviral Infection	Amino acids, Flavonoids, Bioflavonoids, Saponins, Triterpene glycosides (*31*); Thidiazuron, Benzyladenine, Kinetin, Indole-3-acetic acid, Indole-3-butyric acid, Naphthalene acetic acid, Gibberellic acid, and 2,4-Dichlorophenoxyacetic acid (*32*); Carbohydrates and Hydrophilic biopolymers (*33*)	Anticancer, Antiviral, Antidiabetic, Anti-inflammatory, Hepatoprotective, Cardioprotective, Immunostimulant (*48*)
13	*Carlina acaulis* Linn. (Asteraceae)	(caw baza) stemless carline thistle	Flowers, Seeds/ Powder, Juice	Liver Disease	Mineral composition (Macro Micro elements), Vegetable oil, Tocopherols, Protein, Chlorogenic acids, Fatty acids, Amino acids (*49, 50*)	Anthelmintic, Antispasmodic, Diaphoretic, Diuretic, and Emmenagogic (*51*).
14	*Ceratonia siliqua* Linn. (Asteraceae)	(xrnuk) carob	Fruits/ Boiling (Internal)	Abdominal Pain, Diarrhea	Carotenoids, Anthocyanins, Polyphenols, Flavonoids, Tannins, Alkaloids (*52, 53*)	against gastrointestinal-tract diseases, antioxidant, anti-inflammatory, antimicrobial, antidiarrheal, antiulcer, and laxative (*54*)
15	*Cichorium intybus* Linn. (Asteraceae)	(ceq ceqe) chicory	Leaves, Bulbs, Flowers, Roots / Power, Boiling (Internal)	Liver, Gall Bladder	Phenolics, Flavonoids, Saponins, Tannins, Alkaloids, Protein, Glycosides, Carbohydrates, Ca^{2+}, Mg^{2+}, Mn^{2+}, Cu^{2+}, Na^{2+}, Fe^{2+}, Zn^{2+}, Se^{2+} (*55, 56*)	Antimalarial, antibacterial, anthelmintic, antidiabetic (*57*)
16	*Cirsium vulgare* Petr. (Asteraceae)	(kenger) spear thistle	Leaves (Boiling (Internal))	gastrointestinal and kidney diseases	Polyphenolic compounds, Sterols, Esters, Saturated and Unsaturated fatty acids, Aromatic compounds (*58*)	antidiabetic Hepatoprotective, antioxidant, antitumor, anti-inflammatory (*59*)
18	*Cota tinctoria* Linn. (Asteraceae)	(gulla hajila) yellow chamomile	Flowers (Tea, Boiling (Internal)	Fever, Inflammation	Flavonoids, Phenolic acids, Essential oils, Anthocyanins (*60, 61*)	antioxidant (*61*)
19	*Crataegus azarolus* Linn. (Rosaceae)	(gewij) hawthorn	Leaves, Fruits (Dried Parts as a tea, Fresh (Internal)	Heart diseases, Vasodilation	Tannins, Bioflavonoids, Phenolic compounds, Polysaccharides, Oligomeric procyanidins, Saponins, Vitamin C, Cardiotonic amines, Catecholamines, Ursolic acid, Purine (*62, 63*)	antidiarrheal, anti-inflammatory, immunomodulatory (*62*)
20	*Crocus haussknechtii* Boiss. (Iridaceae)	(pishok) crocus	Flowers (Infusion (Internal)	Anti-Septic for gastritis and stomach problems	Polyphenolic and Phenolic acid derivatives, Flavonoids, Chicoric acid, Chlorogenic acid, Ketones, Terpenoids, Amides,	

21	*Dactylorhiza umbrosa* Kreutz. (Orchidaceae)	(salmka) marsh orchids or spotted orchids	Aerial Parts (Infusion (Internal)	Rheumatism	Flavones, carboxylic acids, Aldehydes (*64*) Phenolic and flavonoid derivatives, including quercetin, ascorbic acid, gallic acid (*65-67*)	
22	*Echinops viscosus* DC. (Asteraceae)	(kerteshi) globethistle	Fruits (Powder (Internal)	Git	Phenolic compounds (*68*)	Antioxidant, anticancer, antipyretic, hepatoprotective (*69*)
23	*Eryngium campestre* Linn. (Apiaceae)	(risheke) watling street thistle	Roots (Infusion (Internal)	Cough, Urinary problems, Infections, Kidney Pain	Essential oils, Terpenoids, Coumarins, Flavonoids, Acetylenes, Phenolic acids, Steroids, Saponins (*70*)	
24	*Fumaria parviflora* Hook. (Papaveraceae)	(satere) fumitory	Leaves (Boiling (Internal)	Aerial Parts, Leaves	Alkaloids (Berberine, Oxyberberine, Cryptopine, Fumarine, Parfumine, Protopine); Caffeic acid and Protocatechuic acid; Fatty acids, Volatile oils, Sesquterpenoids, Aromatic hydrocarbons (*71*, *72*)	Antibacterial, Antioxidant, Antitumor, Anti-inflammatory, and Hepatoprotective (*73*)
25	*Lactuca serriola* Linn. (Asteraceae)	(talishk) dandelion root	Leaves (Raw (Internal)	Ulcer	Terpenes, Glycosidic and Phenolic derivatives, Organic acids, Flavonoids (*74*)	
26	*Malva parviflora* Linn. (Malvaceae)	(tollaka) cheeseweed	Leaves (Boiling (Internal)	gastrointestinal trait diseases, Pain, Ulcer	Several elements including Aluminum, Cobalt, Manganese, Iron, Nickel, Selenium, and Zinc (*34*); more than 50 chemical constituents have been extracted from leaves and analyzed by GC-MS (*35*); α-Amyrin, β-Amyrin, Cholesterol, Stigmasterol, β-Sitosterol, Ergosterol, β-Sitosterol-3-*O*-glucoside, Campesterol, Palmitic acid, Linoleic acid, Linolenic acid, Kampeferol-3-(6''-p-coumaroyl-*O*-β-D-glucoside), Chlorophyll A, Chlorophyll B, and Ethyl vanillin (*36*)	Anti-arthritic, anti-inflammatory (*75*)
27	*Mentha spicata* Linn. (Lamiaceae)	(pung) mint	Leaves (Boiling (Internal)	gastrointestinal trait diseases, carminative antispasmodic	Carvone, *cis*-dihydrocarvone, dihydrocarveol, limonene, 1,8-cineole, β-bourbonene, β-pinene, pulegone, piperitone, α-phellandrene, *trans*-caryophyllene, germacrene D (*76*); caffeic acid, Eriocitrin, Rosmarinic acid, Luteolin glucoside (*77*); Alkaloids, Flavonoids, Cardiac glycosides, Saponins, Steroids; more than 48 other constituents (*78*, *79*); fat, proteins, carbohydrates, fiber, moisture, ash, Na^{1+}, Ca^{2+}, K^{1+}, and Fe^{2+} (*80*); Lignans (*81*)	Hepatoprotective, antiemetic, antianxiety (*82*)
28	*Narcissus tazetta* Linn. (Amaryllidaceae)	(nerges) paper white	Flower, Bulb (Boiling (Internal, External)	Headache, Cold, antiparasitic, Abortifacient	phenolic acid and flavonoid derivatives, Pyrrolo[de] phenanthridine, Amaryllidaceae alkaloid (lycorine), galanthamine (*83*, *84*)	Anticancer, sedative, nervine tonic, anti-inflammatory (*85*)
29	*Nasturtium officinale* R.Br. (Brassicaceae)	(kuzalla) watercress	Leaves (Fresh (Internal)	Kidney problems	Carotenoids, Phenols, Vitamin C, Phosphorus, Calcium (*86-88*)	Cardioprotective, Antibacterial, Anti-inflammatory, Anticancer, Antioxidant (*89*).
30	*Papaver bracteatum* Lindl. (Papaveraceae)	(gullalla sura) great scarlet poppy	Leaves and Flowers, (Raw (Internal)	appetite suppressant, Relaxant, Sedative	Essential oils and alkaloids such as Thebaine (Paramorphine), Morphine, Oripavine, Codeine, Rhoeadine, Papaverine; Phenolic compounds (*90-92*)	
31	*Papaver dubium* Linn. (Papaveraceae)	(gule shler) great scarlet poppy	Flowers and Leaves, Raw (Internal)	Sedative, relaxant for nervous System	Alkaloids (Morphine, Codeine, Rhoeadine, Thebaine, Papaverine), Phenolic compounds, Essential oils (*90*, *93*, *94*)	Antimicrobial (*95*)
32	*Piperita mentha* Linn. (Lamiaceae)	(nah nah) peppermint	Leaves (Boiling (Internal)	gastrointestinal-trait, heart, brain, kidney diseases	Alkaloids, Terpenoids, Flavonoids, Phenols, Saponins, Tannins, Cardioactive	Antimicrobial, antiviral, antioxidant antitumor (*99*)

					glycosides, Carbohydrates (*73, 96*); Essential oils, Stilbenes, Phenolic lignans (*97*). Cardiac glycosides, Coumarins, Diterpenes, and Steroids (*98*)	
33	*Plantago major* Linn. (Plantaginaceae)	(rkesha) rib grass	Leaves, Flowers, Latex (Powder, Extracts, hot infusion (Internal, External)	constipation, diarrhea, dysentery	phenols, flavonoids, saponins, tannins [025]; volatile compounds, triterpenoids, phenolic acids and flavonoids (*100*); cardiac glycosides, flavonoids, and phenolics (*101*)	anti-inflammatory, antitussive, anti-hemorrhagic, antiinfection, laxative, hemostatic, astringent, diuretic (*102*)
34	*Rheum ribes* Linn. (Polygonaceae)	(rewas) rhubarb	Roots, Seeds (Fresh, Powder (Internal)	diabetes, vitamin C Supplement, Cancer	Anthrones, Aloe-emodin, Emodin, Emodin glycoside, Physcion, Chrysophanol, Acylglucosides, Pyrones, Stilbenes, Flavonoids (*103*); Tannins and Phenolics (*104*); Alkaloids, Anthraquinones, Quercetin, Quinones (*105*); Palmitic acid, Hydrocarbons and long chain alkanes, including Heneicosane, Tricosane, Pentacosane, and Heptacosane (*30*)	Anti-inflammatory, anticancer, antibacterial, antiviral, expectorant (*106*)
35	*Salix alba* Linn. (Salicaceae)	(dar bi spi) white willow	Leaves (Decoction (Internal)	blood anticoagulant, anti-inflammatory, febrifuge	long-chain Alkanes, Alcohols, Carboxylic acids, Phenolics, Flavonoids, 3-*O*-Glycoside derivatives (*107, 108*)	
36	*Satureja khuzestanica* Jamzad (Lamiaceae)	(jatreh) summer	Stems, Leaves (Raw, Powder (Internal)	indigestion, headache, gastritis	Phenolic compounds (Carvacrol, Thymol), Essential oil, Triterpenes, Flavonoids, Glycosides, Steroids (*109-111*)	Antimicrobial, anticancer (*112*)
37	*Sinapis arvensis* Linn. (Brassicaceae)	(xertal)charlock mustrd,field mustard	Stems, Flowers (Raw (Internal)	Laxative, Stomachache	Erythritol, 2-nitro-propanol, Cyclopentane Methyl Amine, 2-isopropylidene-*N*,*N*,5-trimethyl, Furfural, Thymol, Indole, Benzyl isothiocyanate, Cubenol, Essential oil, Monoterpenes, Sesquiterpenes, Sulfur-containing compounds (*113, 114*)	
38	*Smyrnium cordifolium* Boiss (Araceae)	horse parsley (qalandor)	Stem (Raw (Internal)	Laxative, Stomachache, Headache	Flavonoids, Monoterpenes, Essential oil (*115*)	
39	*Taraxacum officinale* Koch. (Asteraceae)	(talishka) dandelion root	Leaves (Decoction (Internal)	Tuberculosis	Alkaloids, Terpenoids, Phenols, Flavonoids, Glycosides, Saponins, Tannins (*116, 117*)	Anticancer, Antioxidant, Anti-inflammatory, Anti-hyperglycemic, Anticoagulant, Analgesic, Choleretic, Diuretic (*118*).
40	*Thymus vulgaris* Linn. (Lamiaceae)	(catre) thyme	Leaves, Flowers (Boiling (Internal)	Gastrointestinal - trait, heart, and kidney diseases, inflammation, diabetes, obesity	Essential oil (Thymol, p-Cymene, Terpinene, Linalool, Carvacrol), 4-Hydroxybenzoic acid, Vanillic acid, Catechin, Epicatechin, Syringic acid, Gallic acid, Chlorogenic acid, Protocatechuic acid, Caffeic acid, Catechin, *trans*-Cinnamic acid, γ-Coumaric acid, *trans*-Ferulic acid, Kaempferol, Myricetin, Quercetin, Tocopherol, α-Tocopherol, β-Tocopherol, γ-Tocopherol, δ-Tocopherol, Campesterol, β-Sitosterol, Ergosterol, and Stigmasterol (*119, 120*).	Cytotoxic, antioxidant, antimicrobial, mosquitocidal (*121*).

The structures of the most important compounds found in medicinal plants growing in Kodo Mountain are displayed in the following Figs 8-11.

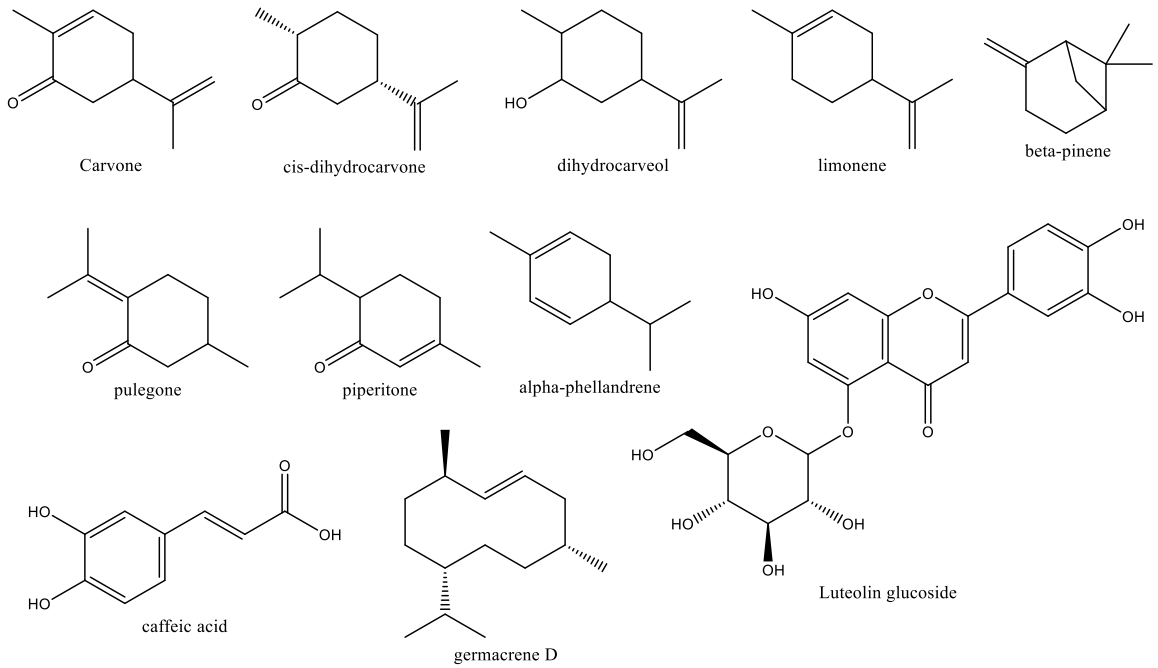

Fig. 8: Chemical structure of some isolated chemicals from *Mentha spicata* L. (**76, 77**).

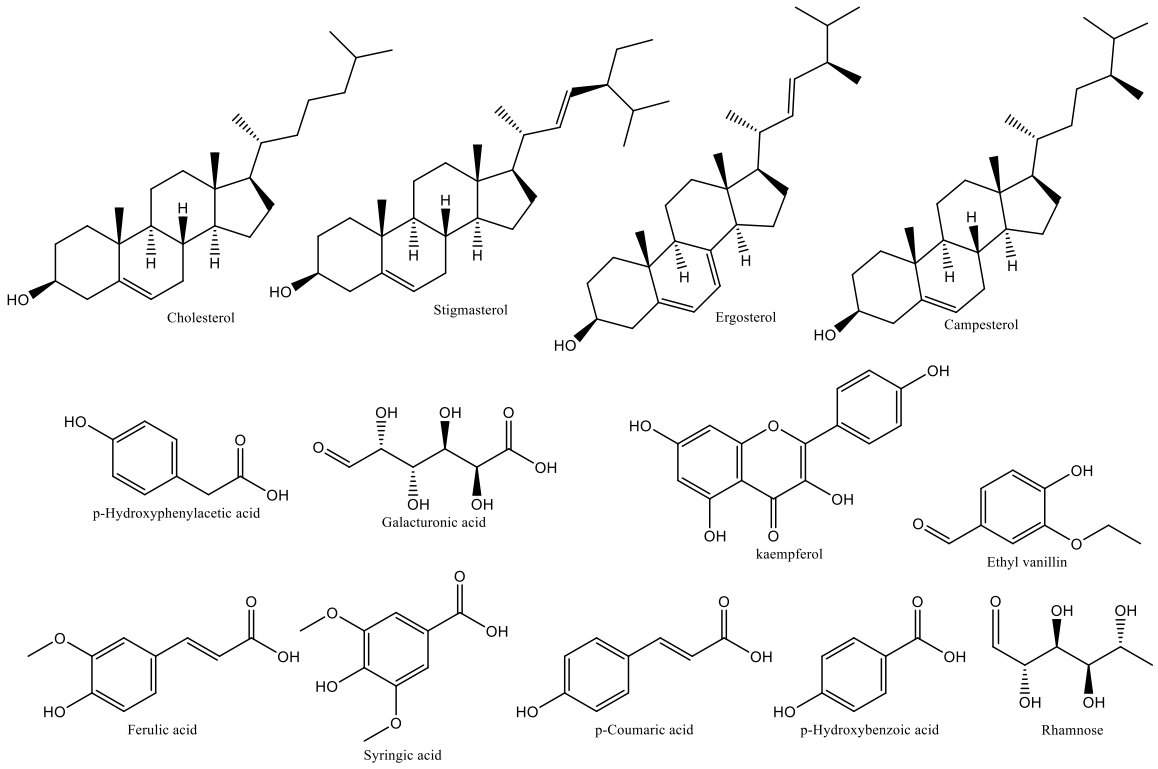

Fig. 9: Structure of the main isolated constituents in *Malvaceae genus* **(21, 22, 26-28, 36)**.

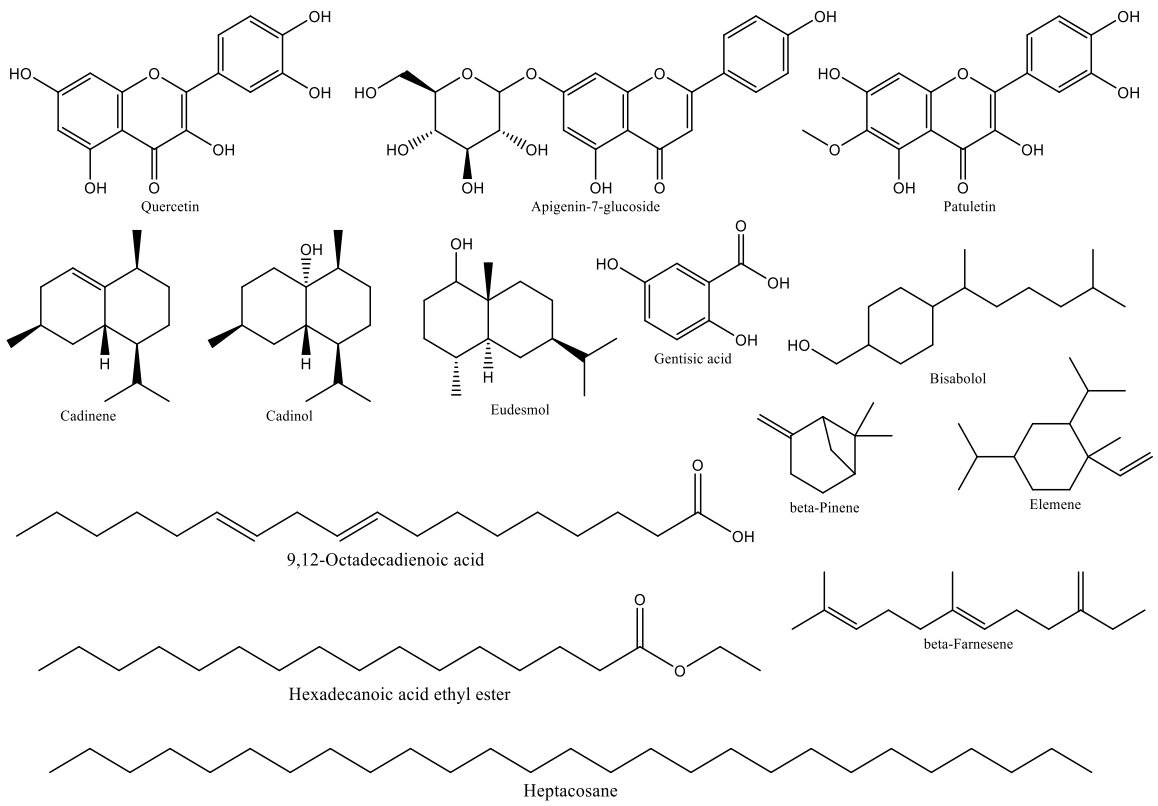

Fig 10. Chemical structure of some flavonoids isolated from *Anthemis des champs(41-43)*

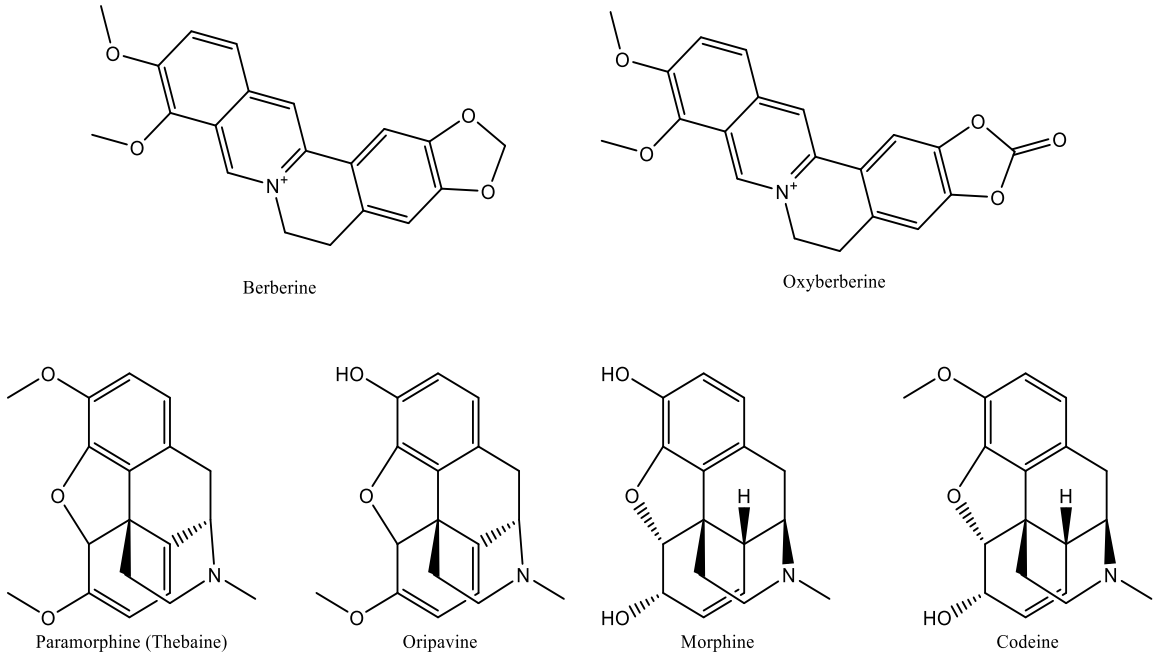

Fig. 11: Structures of the main alkaloids found in different species of plants in Kodo mountain (**90-94**).

Conclusion

Our first ethnopharmacological review of medicinal plants used in the Kodo Mountain, which was based on interviews with local healers, demonstrated that traditional medicine is still widely practiced by this group of Kurds, as well as by other communities of Middle East countries. This fund of knowledge has been passed down through generations only orally; therefore, it is important to keep it in a well-organized form in written documentation, how does this paper want to be. The effectiveness of medicinal plants growing in the Kodo mountain for a wide range of human ailments is not only supported but their prolonged use over time but also by the scientific literature reporting the biological properties of isolated bioactive compounds. However, most data have been obtained from samples of plants collected in other regions; therefore, given the frequent dependence of the contents of secondary metabolites on the plant geographical origin, it is recommendable to examine species native to the Kodo Mountain. Moreover, before considering the local herbal remedies as potential targets for the research of new drugs, more investigations are needed, such as the exploration of the mechanisms of action, and in vivo studies aimed at defining the pharmacokinetic profile, safety, toxic and side effects.

In summary, we believe that this paper demonstrates the great potential of the medicinal plants growing in the Kodo mountain as sources of products for different purposes and applications.

Conflict of Interest

All the authors declare that there are no conflicts of interest.

Acknowledgement

The authors are grateful to Tishk International University (TIU) for supporting this investigation. We also greatly appreciate the Kurdish informants' traditional knowledge of the therapeutic applications of the plants growing in Kodo Mountain.

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