Review Article

Treatment of liver and spleen illnesses by herbs: Recommendations of Avicenna’s heritage "Canon of Medicine"

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Abstract

Objective: Avicenna (Abu Ali al-Hossein ibn Abdullah ibn Sina) who had a special attention toward diseases treatments, gathered results of ages of herbal medicine experiments on humans and animals in his book “Al-Qānūn fī Ṭibb” or "The Canon of Medicine", which is a reliable book in Iranian traditional medicine. The aim of this research was to build a reliable list of plants effective against liver and spleen diseases, based on Avicenna's book (volume 2).

Materials and Methods: By studying the monographs, introduced agents that have been effective in liver and spleen diseases were identified. Upon their origin and effectiveness in diseases of the liver, spleen or both, treatments were organized.

Results: From a huge number of drugs, 163 plants from 73 families were found to be effective in treatment of liver and spleen illnesses. In addition, 30 non-herbal agents effective in treatment of liver diseases were detected. The Lamiaceae family have the most effective herbs for treatment of diseases of the liver, spleen or both. Hemp Agrimony, Irsā, and Fūdhanj achieved the highest scores.

Conclusion: The effects of different plants on liver and spleen diseases were indicated in Avicenna's book. Due to the report on the above book, further studies needed specially on the effect of Irsā (Iris ensata) and family Lamiaceae on liver and spleen diseases.

Keywords:
Herbal medicine
Liver
Materia medica
Spleen

Introduction

The largest organ in the body is the liver, comprising about 2 percent of the total body weight; in an adult with average body mass, the liver is about 1.5 kg. The liver performs many different functions including: 1) filtration and storage of blood; 2) metabolism of carbohydrates, proteins, fats, hormones, and foreign chemicals; 3) formation of bile; 4) storage of vitamins and iron; and 5) formation of coagulant factors (Hall, 2015). Liver diseases are conditions that affect the liver. The liver is prone to diseases due to multidimensional functions and its location (Kumar et al., 2014). The efficiency of current synthetic agents in treating chronic liver disease is not satisfactory and these chemicals have...
undesirable side effects. Thereby, numerous phytochemicals and medicinal herbs, as alternative and complementary treatments, have been investigated for chronic liver diseases (Hong et al., 2015). Iranian traditional medicine (ITM) has been used for prevention, diagnosis, and treatment of diseases and this medicine works based on the humor theory of temperament in which, the liver is one of the most important organs in the body (Akbarzadeh et al., 2015).

Al-Hossein Abu-Ali Ben Abdullah, Ibn Sina, (known as Sheikh al-Rais (or the Prince of the physicians) and in the West as Avicenna, 980-1037 AD) was an extremely talented individual. Avicenna practiced philosophy, astronomy, geometry, mathematics, and medicine as well as poetry and music. Although medicine was not his main area of interest, he became famous as a physician due to the desperate need for thoughtful medical personnel in the Persian kingdom. Among Avicenna’s works, his medical book Al-Qānūn fī Ṭibb, known as Canon in the Western Hemisphere, has a great scientific and historical value. Canon is written in three parts. Part I covers the anatomy and physiology of the human body; Part II includes the description, signs, and symptoms of the disease and Part III describes the treatment of disease and prophylactic measures to prevent disease. For treatment of most diseases, he used food, psychotherapy, and medicinal plants (Qayumi, 1998). Arturo Castiglioni appreciated Avicenna's Canon: "The clarity of the clinical histories, the accuracy of the therapeutic indications, constructed logically and without dangerous exaggerations, and the eloquence of his forcible style were sufficient to confer on this book up to the end of the seventeenth century an almost indisputable authority in the minds of the physicians of all countries" (Galdston, 1955).

Acute liver disease damages the spleen in long term. In Book 2 (the Materia Medica) of Canon, Avicenna alphabetically listed about 806 simple medical agents (of floral, mineral, and animal origin) that were used at the time. Each agent may have different possible general actions, followed by specific properties listed according to symptoms of liver and spleen diseases. In floral monographs of Canon, we found that Avicenna has found that some herbs cure some symptoms so we considered such symptoms and searched for herbs with such properties.

Materials and Methods

In our evaluation, we used different versions of the Canon book available at: (https://sites.google.com/site/avicennacanon1a/canon-web-hmt). This library was created by Dr. Hossein Hatami and is also accessible through the Bu Ali Sina Scientific and Cultural Foundation website (http://www.buali.ir/). The following versions of the Canon were used in our study: 1) The corrected version of Canon in Persian (Sina, 2010), 2) Arabic manuscript of the Canon (Ibn Sina, 2005), and 3) Translated version of the Canon in English (Sīnā, 1998). As the first step, to indicate which herbs have hepatoprotective and other effects for liver diseases, the 2nd volume of Canon was searched. These items were mutually compared and evaluated. Subsequently, data were collected based on different plant species in the areas of healing, and protection. The flow chart of the study is presented in Figure 1.
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Figure 1. The flow chart of the study.

Statistical analysis

The average values for results are expressed as a mean± standard error of mean (SEM). Statistical analysis was performed using the Statistical Package for the Social Science (IBM SPSS statistics version 23) program for Windows. Statistical significance of differences between groups was evaluated using non-parametric statistics, the relationship between the numbers of herbs in each family to score of herbs was shown by the Kruskal–Wallis test p<0.05 was considered statistically significant. Graphs were created with Excel 2013 software (Microsoft office 2013).

Results

Avicenna introduced 193 agents as they were effective on the liver and spleen. Their characteristics are presented in four categories according to the origin of agent in Tables 1-6 which present basic information such as common name, Persian name, Arabic name, scientific name, family, used parts (i.e. root, fruit, etc.)/ mode of consumption (fried, roasted, etc.) or preparation (enema, smell, etc.), diseases for which the agent was prescribed and finally score.

Figure 2. Effective herbs against liver and spleen diseases mentioned in Avicenna’s book. Scores are according to the number of effects that every herb has been prescribed by Avicenna.
Plants

We reviewed all herbs mentioned in the 2nd volume of Canon and found a total of 163 plants used for liver and spleen illnesses. These plants belong to 73 different families. These herbs included medicinal, poisonous, ornamental and economic plants and weeds that are presented in Tables 1-3. According to their effectiveness, they are categorized as effective on liver Table 1, spleen Table 2 and both liver and spleen Table 3. The second volume of the canon book consists of a series of monographs each one describing different properties of one medicinal herb. The monograph name that described the properties of No. 92 herb is lost during repeated transcription through ages so it has indicated as “???” in Table 1. Herb number 93 is a type of endive with no scientific name.

Table 1. Data from Canon book 2 about herbs with hepatoprotective/hepatotherapeutic effects.

| No. | Persian Name | Common name | Arabic name | Scientific Name | Family | Used Parts/ Mode of consumption or preparation | Conditions which the herb has effect on | Score |
|-----|--------------|-------------|-------------|-----------------|--------|----------------------------------------------|---------------------------------------|-------|
| 1   | Piyāz        | Onion       | Baṣi        | Allium cepa     | Amaryllidaceae | J/Twice fried (or roasted)                     |                                      | 1     |
| 2   | Sir          | Garlic      | Thūm        | Allium sativum L. | Amaryllidaceae | J/Enema.                                      |                                      | BH    |
| 3   | Peste        | Pistachio nut | Fustuq    | Pistacia vera L. | Anacardiaceae | J/Smell, oil, syrian variety                  |                                      | 3     |
| 4   | Somāq        | Sumach      | Summāq      | Rhus coriaria L. | Anacardiaceae | J/Pickle                                      |                                      | 2     |
| 5   | Nane havvā   | Ajowan      | Nānkāh      | Curum coticum L. | Apiaceae    | J/Ingestion                                  |                                      | 1     |
| 6   | Zire - biyābāni | Cumin   | Kammūn      | Cuminum cymimum L. | Apiaceae   | J/Polite                                     |                                      | D, RY, PL |
| 7   | Šire - ye - ḳangōdān, saļqun | Asafoetida | Hiltit    | Ferula assafoetida L. | Apiaceae | J/Polite                                     |                                      | 1     |
| 8   | Sakkne       | Sagapanum   | Sakbinaj    | Ferula persica Wild. | Apiaceae   | J/Polite                                     |                                      | 3     |
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| No. | Name          | Part Used          | Plant Name                                                                 | Family        | Treatment                                                                 | PL, J | Notes              |
|-----|---------------|--------------------|----------------------------------------------------------------------------|---------------|---------------------------------------------------------------------------|-------|--------------------|
| 9   | Sefandafal aiun, safandulûn | Root | Heceileum spondylium L. | Apiaceae | / Ingestion                                                               |       |                    |
| 10  | Gāz[']janga bin e estabarak' | Root | Sukkar al-'ish', ushr | Apocynaceae | / Ingestion                                                               | D, GL |                    |
| 11  | Mārčube, mawāqīn mawāqīnas, asfārāghas, | Root | Asparagus officinalis L. | Asparagaceae | Root, seed / cooked                                                      | OL, J |                    |
| 12  | Alva' | Small aloe | Aloe littoralis | Asphodelaceae | / Oral intake                                                            | HBF, OL, J, EXB |                    |
| 13  | Xonsā | Asphodel | Asphodelus tenuifolius | Asphodelaceae | / Oral intake                                                            | J     |                    |
| 14  | Kāsni | Endive, chichory | Lactuca sativa L. | Asteraceae | / Bitter variety                                                          | OL, UL, EXC, LT | J                   |
| 15  | Kāhu | Lettuce | Matricaria chamomilla L. | Asteraceae | / With vinegar                                                            | J     | 1                  |
| 16  | Bābune | Chamomile | Onopordon arabinum L. | Asteraceae | UL                                                                         | OL     | 1                  |
| 17  | Kangare xar, čarxe | Multi-knotted Arum | Colocasia antiquorum | Araceae | BD                                                                         |       |                    |
| 18  | Gušfil | Balsam | Commiphora opobalsamum (L.) Engl. | Burseraceae | / Cooked                                                                  | J     |                    |
| 19  | Zerešk | Horse radish root | Raphanus agria | Brassicaceae | Fruit                                                                      |       |                    |
| 20  | 'Afysus, 'Anus | Horse radish root | Raphanus agria | Brassicaceae | Fruit                                                                      |       |                    |
| 21  | Bašām | Balm of gilead balsam | Balsān, balšān makki | Araceae | / Cooked                                                                  | STJ   |                    |
| 22  | Nārmošk | Iron wood | Mesua ferrea L. | Calophyllaceae | CL                                                                         |       |                    |
| 23  | Šähdāne | Shahdanaj, hemp seed | Cannabis sativa L. | Cannabaceae | / Juice= shāhdānaj                                                       | EXB   |                    |
| 24  | Esfe(a)nāj' | Spinach | Spinacia oleracea L. | Chenopodiaceae | CB                                                                         |       |                    |
| 25  | Mahmude | Scammony | Convulvulus scannonia | Convolvulaceae | / Root / oral intake                                                      | PB    |                    |
| 26  | Košus | Dodder | Cuscuta reflexa | Convolvulaceae | / Orally, juice                                                          | OL, STL, J | 3                  |
| 27  | Motā | Dogwood | Cornus mascula | Cornaceae | / Orally, juice                                                          | CL, GIL | 2                  |
| 28  | Šarang, hendavāne -ye abuajahl' | Hanjal | Citrullus colocynthis L. | Cucurbitaceae | Root                                                                      | D     | 1                  |
| 29  | Simāhāng, xīyār e ḍilāq | Squiring | Momordica elaterium L. | Cucurbitaceae | Roots, leaves, barks / extract, orally, decocted Fruits                  | J, D, VB, EVY | 4                  |
| 30  | Šāri, avers' | Shabin, cedar tree | Chamaecyparis sp. | Cupressaceae | UL                                                                         |       |                    |
| 31  | Mo(e)šik e za(e)niaš | Indian cypress | Cypress rotundus L. | Cupressaceae | PH                                                                         |       |                    |
| 32  | Dome šejte, shenge ćamani | Horse tail | Equisetum arvense L. | Equisetaceae | IL                                                                          |       |                    |
| 33  | Māhūdāne | Caper-spurge, myrtle spurge, wild caper | Croton tiglium L. | Euphorbiaceae | Seed                                                                       | D, PB | 2                  |
| 34  | Gāvkašk | Spurge, Shabram | Euphorbia pithyusa | Euphorbiaceae | / Orally, soaked                                                          | D     | 1                  |
| 35  | Karčak | Castor, Kheroo | Ricinus communis L. | Euphorbiaceae | Seed / attrited                                                           | EXB   | 1                  |
| 36  | Rame | Soap nut | Caesalpina bondoc (L.) Roxb. | Fabaceae | / Scuash                                                                  | EBB, EVY, J, I |                    |
| 37  | Xiyaršamb | Purging cassia | Cassia fistula L. | Fabaceae | CIL, J, PL, EVY                                                           |       |                    |
| No. | Common Name | Scientific Name | Family | Part Used |
|-----|-------------|-----------------|--------|-----------|
| 38  | Xarnub      | Ceratonia carob, nabatean carob, yanbūt | Fabaceae | J          |
| 39  | Taranja(e)  | Manna Taranjubin, alhāji - maursorum, xāršotor | Fabaceae | PB         |
| 40  | Tamre hendi | Tamarind Tamr hind | Fabaceae | PB         |
| 41  | Nee y nahāvandi, ney e zainre | Chiratta Qasab al-dharrirah, dharrirah | Gentianaceae | IL, D |
| 42  | Lāk         | Lac Luk | Coccus lacca | Kerriidae |
| 43  | Na'nah'     | Spicata spearmint Nānāt | Lamiaceae | J          |
| 44  | Sangol, zufta ye tar | Sumarn, toxm e zarāb | Lamiaceae | CL, D |
| 45  | Pune koohi, marze ye koohi, marze | Origanum Sa'tar | Lamiaceae | LD |
| 46  | Dārčin khateri | Cassia bark Salikhah | Cinnamomum cassia auct. | Lauraceae |
| 47  | Dārčin      | Cinnamon Dāršini | Cinnamomum zelanicum Blume var. cassia Nees | Lauraceae |
| 48  | Anār'       | Pomegranate, carthaginian apple Rummān | Cinnamomum aromaticum | Lauraceae |
| 49  | Molukiye, panirake bostāni, panirake kāštani | Mulūkhiā, khubbāri | Corchorus olitorius L. | Malvaceae |
| 50  | Garmdāne, gardmāne | Kermes Karam dānah | Coccus cacti | Monophlebidae |
| 51  | Mixak       | Cloves Qaranful | Caryophyllus aromaticus L. | Myrtaceae |
| 52  | Mud         | Myrtle Ās | Myrtus communis L. | Myrtaceae |
| 53  | Zeytun      | Oliva Zaitūn(al-zait) | Olea europea L. | Oleaceae |
| 54  | Gol e jāliz | Maltesa mushroom Țarāthith | Orobanche caryophyllea | Orobanchaceae |
| 55  | Favina, gol e sad tu(o)māni  | Peony Fāwānīa, 'Ūd al-ṣalib, dhā al-āsihi, 'al'isi Khashkhash, manpur, khashkhash | Orobanche caryophyllea SM | Orobanchaceae |
| 56  | Xašxāš, xāxāš | Papaver Glaucum flavum Grant | Papaveraceae | Papaveraceae |

**Notes:**
- **PB:** Powder
- **J:** Juice
- **IL:** Infusion
- **LD:** Decoction
- **CB:** Paint oil
- **OL:** Garden variety, Wild variety
- **PL:** Paint oil, sediment
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| No. | Herb Name     | Family               | Scientific Name                        | Part Used              | Treatment                  | Reference |
|-----|---------------|----------------------|----------------------------------------|------------------------|---------------------------|-----------|
| 58  | Zardkūbe      | Turmeric             | Chelidonium majus L.                    | Papaveraceae           | Oral                      | OJ, OL    |
| 59  | Šāhtare       | Fumitory             | Pumaria officinalis L.                  | Papaveraceae           | Oral                      | OL, I     |
| 60  | Vāle          | Rock moss            | Peramedia perlata                      | Parmeliaceae           | Soaked in some constipating wine | PL        |
| 61  | Tānnūb        | Abies, fir           | Usnea sp.                              | Pinaceae               | LI                        |           |
| 62  | Se(s)amo[w]   | Pine, common fir tree| Pinus pinea L.                         | Pinaceae               | Bark and leaves / oral intake | PL        |
| 63  | Bārhang       | Great plantain, multi angled, seven angled | Plantago major L.                     | Plantaginaceae         | Roots, seeds and leaves, extract / a dish of lentil containing great plantain, orally, enemas | OL, D, BD |
| 64  | Esfarzā, as pīgul | Isphahola, spogel seed | Plantago ovata Forsk.                 | Plantaginaceae         | Mucilage                  | BT        |
| 65  | Gurb gāyāh    | Bug rush             | Andropogon schoenanthus L.             | Poaceae                | Flowers / oil             | I, IL, D  |
| 66  | Tabāštār, xeyzarān | Bamboo concretion | Bambusa arundinacea Retz.              | Poaceae                | Wood / ash, paint         | SIN, BD   |
| 67  | Rīvāš        | Ribes purslane       | Rheum ribes L.                         | Polygonaceae           | / Syrup or paste, enema    | BD        |
| 68  | Xorf         | Baqla hamsaq, farākāh, Lisān al-hamal | Portulaca oleracea L.                | Portulacaceae          |                          | RB, IRL, |
| 69  | Kabābē        | Cubeb                | Cubeba officinalis Raf.                | Piperaceae             |                           | VB, BD    |
| 70  | Marmirān      | Golden threat root   | Māmirān                                | Ranunculaceae          | Root                      | J         |
| 71  | Xarbaq e siyāh | Black hellobore      | Helleborus niger L.                    | Ranunculaceae          |                           | EBB       |
| 72  | Zālāzālak, Azarove | Za'rūr, tarqānāthin | Craetaegus melanocarpa L.              | Rosaceae               |                           | EY, PE    |
| 73  | Panj barg, Nīzāfūli | Five leaf grass, cinquefoil | Potentilla reptans L.                | Rosaceae               | Milk, root / extract      | J, PL     |
| 74  | Ālu'          | Bukhara plum         | Ijās                                    | Rosaceae               | Old, sweet variety, fresh | EXB       |
| 75  | Golābī        | Kummatharā           | Prunus domestica L.                    | Rosaceae               |                           | REB, BD   |
| 76  | Gol e sorx    | Rose Ward            | Rosa damascus                          | Rosaceae               | Dry flowers / oil         | CM, GL, BD |
| 77  | Senjed        | Service tree         | Ghubairā                                | Elaeagnaceae           |                           | SIN       |
| 78  | Uruj , tora(ojn) , bālang | Citron               | Citrus medica L.                        | Rutaceae               | / Collury, juice          | RB, J, VB, BD, EJ |
| 79  | Fāxrē         | Split cubeb          | Zauthocylum alatum                    | Rutaceae               | / Incorporated in medicines | CL        |
| 80  | Bid e biyābānī | Goat willow          | Khili'f                                 | Salicaceae             | Juice                     | OL, J     |
| 81  | Mehrgiyāh     | Belladonna           | Mandragora officinarum L.              | Solanaceae             | Sap                       | VB, PB    |
| 82  | Kakav(o)ne, arasak(e pošt e parde) | Winter cherry, alkekengi, bladder | Physalis alkekengi L.                 | Solanaceae             | J                       |           |
Table 2. Properties of herbs that were found effective against spleen disease, mentioned in the 2nd volume of Canon.

| No. | Persian name | Common name | Arabic name | Scientific Name | Family | Used Parts/ Mode of consumption or preparation | Conditions which the herb has effect on | Score |
|-----|--------------|--------------|-------------|-----------------|--------|---------------------------------------------|---------------------------------------|-------|
| 1   | Karaf koohi  | Rock-parsley, southern wood | Būyānas | *Petroselinum sativum* Hoffm, nom. nud. | Apiaceae | SS | 1 |
| 2   | Čatālānqūs, saqzez, bane | Terebinth | Habba al-khadrī, 'botm | *Pistacia terebinthus* L. | Anacardiaceae | Resin, gum | SD, I | 2 |
| 3   | Ašaqe' | Labdanum | Qisṭūs, gheysus Kabur | *Hedera helix* L. | Araliaceae | Fresh / plastering | US | 1 |
| 4   | Kabar | Caper, caprifole | Fāshrī, karmā bădī, hazārjāshān | *Capparis spinosa* L. | Capparidaceae | Root-bark / orally or plaster | HS, EM | 2 |
| 5   | Hezār gušān, fāserā, tāk e safid | White bryony | Fāshrī, karmā bădī, hazārjāshān | *Bryonia alba* L. | Cucurbitaceae | | GS | 1 |
| 6   | Nil | True indigo | Nil | *Indigofera linifolia* (L.f.) Retz. | Fabaceae | Wild variety | S | 1 |
| 7   | Bī' al | Alfalfa | Abī' al | *Medicago sativa* L. | Fabaceae | | US | 1 |
| 8   | Šambh(o) ile | Fenugreek | Hūlbāh, | *Trigonella foenum-graecum* L. | Fabaceae | / painted | US | 1 |
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| No. | Persian name | Common name | Arabic name | Scientific Name | Family | Used Parts/ Mode of consumption or preparation | Conditions which the herb has effect on | Score |
|-----|--------------|-------------|-------------|-----------------|--------|-----------------------------------------------|----------------------------------------|-------|
| 1   | Agar'        | Sweet scented flag | Waj         | Acorus calamus L. | Acoraceae | Roots, leaves / dried, orally               | CH, STL, HS, SHS, SD, H                    | 4     |
| 2   | Falanje      | Leek        | Hirbah      | Allium porrum Syn. Allium ampeloprasum L. | Amaryllidaceae | Peels, leaves / dried, orally             | S, STL, LD, LW, IL, GL, GS, D, TL, CL, HS, LH, D | 2     |
| 3   | Mastaki      | Mastic, mastic tree gum | Maštaki      | Pistacia lentiscus L. | Anacardiaceae | Roots / taken orally, plaster              | S, STL, LD, LW, IL, GL, GS, D, TL, CL, HS, LH, D | 4     |
| 4   | Karafs       | Ceieriy     | Karafs      | Apium graveolens L. Dorema ammoniacum (D.Don) Syn. Gum ammoniacum Morina amniacum (D.Don) Syn. Gum ammoniacum | Apiaceae | Seed / orally                               | S, STL, LD, LW, IL, GL, GS, D, TL, CL, HS, LH, D | 5     |
| 5   | Oše'         | Ushaq, lazaq al zahab, tarthoth | Ushaq      | / used internally, painted                      | Apiaceae | / used internally, painted                  | S, STL, LD, LW, IL, GL, GS, D, TL, CL, HS, LH, D | 3     |
| 6   | Gāvšir       | Opopanax, galbanum | Jāoshir     | Opopanax chironoum, (L.) Koch.                  | Apiaceae | / juice, with vinegar, syrup, extract, plaster, ointment, pessary | HS, S, D                               | 3     |
| 7   | Anistūn, rūziyāne numi | Anise, anis | Anistūn     | Pimpinella anisum | Apiaceae | / /Infusion (naqi')                         | OL, OS                                  | 2     |
| 8   | Barbāle      | Indian valerian | Asārūn      | Aserum europaeum L. | Aristolochiaceae | / Infusion (naqi')                         | D, OL, LH, HS, J, GD, SD, GS, SB          | 3     |
| 9   | Sarāwand     | Zara land, Indian birthwort | Zarāwand,arestokhā | Aristolochia longa L. Syn. Aristolochia fontanesii | Aristolochiaceae | round variety / with oxymel, painted, powdered, orally | D, OL, LH, HS, J, GD, SD, GS, PB | 3     |
| 10  | Zangidāru    | Spleen wort  | Saqqūliqand rūnī, kaf al-nasr | Asplenum scrophiendium L. | Aspleniaceae | Leaves / decocted                           | GS, SD, J                               | 3     |
| 11  | Afsantin, dē(m)jīmanum numi | Absinth, absinthe, worm wood | Afsantin    | Artimisia absinthium L. | Asteraceae | / syrup, extract, plaster, ointment, pessary | J, D, US, PL, LH, PB, BH                | 7     |

Abbreviations: SS: sclerosis of spleen; SD: Splenic disease, splenic disorders; I: Itch, urticarial, prurigo, scabies; US: useful for spleen, useful in splenic ailments; PBB: Purge out black bile, HS: Hardness of the spleen, splenic hardness; EM: Evacuates the thick melanotic matters of the spleen; GS: Good for spleen, good drugs for the spleen; S: Splenitis; SSW: splenic swelling; BJ: Useful in black jaundice, melanotic jaundice; D: Dropsy (Ascites); SI: Spleen inflammation; SHS: shrinks the (enlarged) spleen, emaciates the spleen, splenic enlargement, reduces the size of the spleen.

Table 3. Plants used as medicinal agent in liver and spleen.
| No. | Herb                                      | Scientific Name                      | Family            | Use                                      | Authors                            | Page |
|-----|-------------------------------------------|--------------------------------------|-------------------|------------------------------------------|------------------------------------|------|
| 12  | Moškāniyye                                | Ghāfīth                              | Asteraceae        | / oral intake, extract                    | I, PL, OL, STL, LH, H, D           | 7    |
| 13  | Babune gāv če(a)jšan, andrīčan, aqasnum, quarinbun | Uqhuwān                              | Asteraceae        | / oil                                     | PBB, SS                           | 2    |
| 14  | Šire ye. Fil zahre                         | Extract of ophthalmic berbery        | Berberidaceae     | / oral intake or external painting of     | SD, BJ                             | 2    |
|     |                                               | Shahjār, dyster’s bigloss            |                   | Indian variety, oral intake, plasters,   | J, SA, CLL, SD                     |      |
| 15  | Gole qašed                                | Hoqād hendi                          | Lappaceae         | / decoction                               | I, SA, BH                          | 3    |
| 16  | Hovečube                                  | Aḥšī halsā, aḥšī Khalsā, shenjar     | Anchusa tinctoria | / decoction                               | J, SD                              | 2    |
| 17  | Kalam                                     | Kurünb                               | Brassicaceae      | Leaves / extract                          | OL, OS                             | 2    |
| 18  | Barqast                                   | Qunna barā                            | Brassicaceae      | / extract                                 | PH, SHS, VB, EL                     | 4    |
| 19  | Toxm tarezak biyābāni, sāḥtare             | Hurf                                 | Brassicaceae      | Babylonian cress / plaster               |                                   |      |
| 20  | Tor(ø)b                                  | Fūj                                  | Brassicaceae      | Seed, leaves / plastered, extract,        |                                   |      |
| 21  | Sonbol, sonbole hendi                      | Sunbul                               | Caprifoliaceae    |                                          |                                   |      |
| 22  | Palaxam                                   | Kundus                               | Caryophyllaceae   |                                          |                                   |      |
| 23  | Selq                                      | Sīlq                                 | Chenopodiaceae    |                                          |                                   |      |
| 24  | Halīle                                    | Halīlaj                              | Combricateae      |                                          |                                   |      |
| 25  | Lablāb                                    | Lablab                               | Convolvulaceae    |                                          |                                   |      |
| 26  | Faqilāsus, bo(e)xor maryam                | Faqilāminitā, buktūr maryam          | Cucumis sativus   | /oral intake, extract, plastered         |                                   |      |
| 27  | Noxod                                     | İmmnaş                               | Fabaceae          | / flour, decoction, coloured and black    | D, J, OL, OS                       | 4    |
|     |                                           |                                      |                   | varieties                                |                                   |      |
| 28  | Lubīyā gorgi                               | Turms                            | Fabaceae          | / cooked                                  |                                   |      |
| 29  | Gole gandom                               | Common centaury                     | Gentianaceae      | / decoction                               |                                   |      |
| 30  | Je(a)ntiyānā                              | Jantīnā, kaf to zoe’b                | Gentiana lutea    | / taken with wine                         |                                   | 6    |
| 31  | Ishqil                                    | Ishqil                               | Hyacinthaceae     | / it's viniger, decotion, kept hanging    |                                   | 5    |
| 32  | Za’fe(a)rīn                               | Za’farān                             | Iridaceae         | / oil                                     |                                   | 2    |
|     | Susan                                     | Sausan                              | Iridaceae         |                                          | ST, GS                             | 2    |
| 33  | Zambah, iris                              | Liris                               | Iridaceae         | / with vinegar, internal and external     |                                   | 7    |
|     | Orris root                                | Liris                               | Iridaceae         | use, old powdered,                       |                                   |      |
| 34  | Mās dāru                                  | Tecrum                               | Lamiaceae         |                                          |                                   |      |
| 35  | Hesl , zufā ye xotāk                      | Zatfā yābīs, zavān                   | Lamiaceae         | / plastered, oral intake                 |                                   | 2    |
| 36  | Hyssop                                    | Hyssopus officinalis L              | Lamiaceae         |                                          |                                   |      |
### Avicenna's herbs for treatment of liver and spleen illnesses

| No. | Herb Name | Part Used | Genus | Family | Action | Abbreviation |
|-----|-----------|-----------|-------|--------|--------|--------------|
| 37  | Gandrū ye koojh | Black horehound Mint | Farāsīn', alqam | Fūdhanj | Marrubium vulgare L. | Lamiaceae | OL, OS | 2 |
| 38  | Pune | Common germander Chaste tree | Kamādhrūs, kamāzhrūs | Banjanjush | Mentha piperita L. | Lamiaceae | BC, BO, BL, J, D, SHS, RBB | 7 |
| 39  | Maryam noxodi | Common germander Chaste tree | Kamādhrūs, kamāzhrūs | Banjanjush | Tenecrium chaumaedrys L. | Lamiaceae | HS, MJ | 3 |
| 40  | Panj' tangošt | Common germander Chaste tree | Kamādhrūs, kamāzhrūs | Banjanjush | Vitex agnus-castus | Lamiaceae | OL, OS, SS, D | 4 |
| 41  | Dahmāšt | Bay tree, seed of laurel Fig, fig tree | Dahmush, qār, hab al-ghār | | Laurus nobilis L. | Lauraceae | H, S, PL | 3 |
| 42  | Anjīr | Persian lilac | Bān | Moringa arborea Verdcourt | Moringaceae | OL, OS, D, SS, L, SL, SS, US | 3 |
| 43  | Hab[b] al bān | Persian lilac | Bān | Moringa arborea Verdcourt | Moringaceae | OL, OS, D, SS, L, SL, SS, US | 3 |
| 44  | Čārgun, bazbūz, basbāse | Common polypody White agaric | Bīsbāsah, jauz būwā | Polypodium officinalis | Polypodiaceae | PBB, PB | 2 |
| 45  | Baaspāyak | White agaric | Bīsbāsah, jauz būwā | Polypodium officinalis | Polypodiaceae | J, SL, PL | 3 |
| 46  | Qārē deraxti | White polypody | Gharqūn | | Polysporus angulatus | Polyporaceae | RB, I, BJ, SS | 4 |
| 47  | TorSak | White polypody | Hummūd | Rumex crispus L. | Polygonaceae | RB, I, BJ, SS | 4 |
| 48  | Rivand, rivand: ečīni, behman, rāvand | Himalayan rhubarb | Riwand | Rheum officinale L. | Polygonaceae | LD, PL, LW, SHS | 4 |
| 49  | Parsiyyāvo(a)ākān | Maiden hair | Barsliushān | Adiantum capillus veneris L. | Pteridaceae | SA, J | 2 |
| 50  | Bādān | Almond | Lauz | Amygdalus communis L. | Rosaceae | OL, OS, GS, SU, S, SCL, CSL, OS | 5 |
| 51  | Ru(o)nās | Dyers madder | Fūwah al-sabbāghīn | Rubia tinctorum | Rubiaceae | OL, OS, GS, SU, S, SCL, CSL, OS | 5 |
| 52  | Fajjan | Common rue | Sozāb, sodāb | Ruta graveolens | Rutaceae | S, J | 2 |
| 53  | Filzhare | Common rue | Filzhra  | Lycium arabicum L. | Solanaceae | J | 2 |
| 54  | Hafīnbarg | Mazerion | Mādhrūm | Daphne mezereum L. | Thymelaeaceae | D, BD, PBB | 3 |

Abbreviations: CH: Cold hepatalgia; STL: strengthens the liver; HS: Hardness of the spleen, splenic hardness; SHS: shrinks the (enlarged) spleen, emaciates the spleen, splenic enlargement, reduces the size of spleen; SD: Splenic disease, splenic disorders; H: Hepatitis; S: Splenitis; LD: Liver disease; LW: Liver weakness; IL: Inflammatory conditions of the liver; GL: Good for liver; GS: Good for spleen, good drugs for the spleen; D: Dropsy (Ascites); TL: tones up the liver; CL: Strengthens 'cold' liver, 'coldness' (atony) of the liver, suitable for the 'coldness' of the liver; LH: Liver hardness; OL: Removes the obstructions of liver, removes hepatic obstructions, de obstructum for the liver; OS: Obstructions of spleen, de obstructum for the spleen; J: Jaundice; GD: General Dropsy (anasarca); PB: Purged out bile, purges out the 'burnt' bile; US: useful for spleen, useful in splenic ailments; PL: Pain of the liver, hepatalgia, painful conditions of liver; BH: Remove bilious humours, expels bilious humours; I: Icht, urticarial, prurigo, scabies; PBB: Purged out black bile; SS: sclerosis of spleen; BJ: Useful in black jaundice, melanotic jaundice; SA: Splenalgia, splenic pain; CLL: Cleanses the liver, cleanses (the foul humours of) the liver; PH: Produces heat in liver, warming drug for liver; VB: vomiting of bile, stops biliary vomiting, bilious vomiting; EL: Expels bile through loose motion; SI: Spleen inflammation; DB: Diluent black bile; UB: useful for bile ailments; EBB: Evacuates the black bile; EHY: Evacuates the yellow bile, evacuates the burnt bile; SSW: splenic swelling; DI: Dissolves inflammation of the spleen; BI: Biliary ileus; CS: Cold spleenalgia; EXB: Expels yellow bile; EB: Expels the black bile; MJ: Melanotic jaundice; BC: Bile clean up; BO: Bile opener; BL: Bile laxative; RBB: Remove black bile; SL: Sclerosis of liver; STS: strengthens the spleen; RB: Removes yellow bile; SU: Stirs up yellow bile; CLS: Cleanses the spleen; BD: Useful in bile diarrhea, bilious diarrhea, stop bilious diarrhea.
The most common effective plants prescribed for liver or spleen diseases or both, are shown in Figure 2. Figure 3 shows the plant families (i.e. Lamiaceae, Fabaceae, Apiaceae, Rosaceae, Asteraceae, Solanaceae, and Brassicaceae) with the largest contribution to development of treatments against liver and spleen diseases.

**Animals**

The majority of the 17 agents of animal’s origin including animal, organs or animal physiological fluids used as medication. In certain cases, especially for insects, the whole body was used, and in other cases, the animal’s urine or even the milk was used. The animals and their applications are presented in Table 4.

The used animals can be divided into groups according to their availability, such as domesticated animals, such as jennet, goat, camel, cow, and others such as locust and worms. Wild animals, for example, wolf, sand grouse, red-headed partridge, hedgehog, porcupine, antelope, and stag. Various organs, and products of exotic animals, species such as Spanish fly, coral, oyster have been used in order to cure liver and spleen diseases.

**Table 4. Animals and their parts used as a source of medication.**

| No. | Persian name | Common name | Arabic name | Scientific Name | Family | Used Parts/ Mode of consumption or preparation | Diseases Which the agent has Effect on | Score |
|-----|--------------|-------------|-------------|-----------------|--------|-----------------------------------------------|--------------------------------------|-------|
| 1   | Badal e marjān | Coral | Bussad | Corallium rubrum | Coralliidae | / mixed with water | SSW | 1 |
| 2   | 'Edrār | Urine | Baul | Peri ooron | | Drink / Human, camel | | 5 |
| 3   | Malax | Locust | Jarād | Locusta migratoria | Acridida | / the red multi legged worms with wine | J | 1 |
| 4   | Kerm | Worm | Dūd, dūd al-ṣabāghin | | | | |
| 5   | Ka'f e daryā | Sea foam, casting of king fisher | Zabad al-ḥabīr | Aleyonium | Aleyoniidae | Rosy kind | SD, D | 2 |
| 6   | Jegar | Liver | Kabid | Hepar Gała | Wolf liver | Milk, Cheese water, | PL | 1 |
| 7   | Šayyer | Milk | Laban | | | | 11 |
| 8   | Gušt | Meat | Laḥm | | | | |
| 9   | 'Madfu | Faeces, excreta, stool | zibl | Dung | Sand grouse Hedgehog | Doogh, Boiled sour milk | D, OL, OS, LW | 6 |
| 10  | 'Osto(e)xān | Bones | ʿizām | Os | Goat, mountain goats | Oral intake / plaster or paint, taken with some aromatics | J, JS | 3 |
| 11  | Sadaf | Pearl, oyster shell | Farofas | Oyster | | | SD, D | |
| 12  | Šāx e jānevarān | Horn | Qarn | Cornu | | | D, J | 2 |
| 13  | Sang xānak | Sand grouse Porcupine | Qaṭā | Hystris cristata | | Fleshy/salted liver / sun dried meat | D, Phb | 2 |
| 14  | Xārpošt e biyābān | Red headed partridge | Qabaj, ghag | | | | D | 1 |
| 15  | Kabk | Earth worm | Kharāṭin Dharāṭiḥ | Lumbricus | | | J | 1 |
| 16  | Kerm e sorx | Spanish fly | Lumbricidae Trochidae | | | | D | 1 |

| Abbreviations: SSW: splenic swelling; I: Itch, urticarial, prurigo, scabies; D: Dropsy (Ascites); HS: Hardness of the spleen, splenic hardness; J: Jaundice; SD: Splenic disease, splenic disorders; PL: Pain of the liver, hepatalgia, | |

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painful conditions of liver; LD: Liver disease; IL: Inflammatory conditions of the liver; GL: Good for liver; EXB: Expels yellow bile; BD: Useful in bile diarrhea, bilious diarrhea, stop bilious diarrhea; OL: Removes the obstructions of liver, removes hepatic obstructions, de obstruent for the liver; OS: Obstructions of spleen, de obstruent for the spleen; LW: Liver weakness; PF: Prevents the flow of bile towards the viscera, prevents the infiltration of yellow bile towards the intestines; Pbb: Produces black bile.

### Table 5. Minerals noted in Canon by Avicenna.

| No. | Persian name | Common name | Arabic name | Scientific Name | Used Parts/ Mode of consumption or preparation | Diseases Which the agent has Effect on | Score |
|-----|--------------|-------------|-------------|-----------------|-----------------------------------------------|----------------------------------------|-------|
| 1   | Mum[i]yā | Asphat, mineral pitch, jews pitch | Mūmiāi | Asphaltum | Snuff, oral use | LI, SA | 2 |
| 2   | Namak e čini, gel e Aṣiūs | | Asian stone | | / Painting | US | 1 |
| 3   | Borax | Būraq | Nātrion | Plaster | | D, I | 2 |
| 4   | Āhan' | Iron | Hadīd | Extinguished hot iron in wine and water | from a sunny land / Painted | D, S, GD | 3 |
| 5   | Gel e ma'muli | Common earth | Muqla | Bolas armenas rabra | PL | 1 |
| 6   | Gel e maqarra | Red ochre | Maghra | | | |
| 7   | Āb' | Water | Mā' | Iron rich water, Copper containing water | Sea-water / vapours | US | I |
| 8   | Namak | Salt | Milḥ | Sodium chloride | / Paint | I | 2 |

Abbreviations: LI: Liver injuries caused by fall, damaged liver; SA: Splenalgia, splenic pain; US: useful for spleen, useful in splenic ailments; D: Dropsy (Ascites); I: Itch, urticarial, prurigo, scabies; S: Splenitis; GD: General Dropsy (anasarca); PL: Pain of the liver, hepatalgia, painful conditions of liver; IL: Inflammatory conditions of the liver; SI: Spleen inflammation; BB: Bile break.

### Table 6. Processed agent used in medicine in canon in medicine medication by Avicenna.

| No. | Persian name | Common name | Arabic name | Scientific Name | Used Parts/ Mode of consumption or preparation | Diseases Which the agent has Effect on | Score |
|-----|--------------|-------------|-------------|-----------------|-----------------------------------------------|----------------------------------------|-------|
| 1   | Serke | Vinegar | Khal | Acetum vinegar | / Fumigation | D | 1 |
| 2   | Nešāste | Starch | Nashā | | / Oral use | BD | 1 |
| 3   | La'l e moor'bberi | A resin | Qaṣqah, qaṣqahar | Qaṣqah | / Orally | SHS | 1 |
| 4   | Panir | Cheese | Juhn | Serparium | The water of cheese | PBH, EXB | 2 |
| 5   | Omaali, ormaali, asal' e dāvi, ûw[geh] e asal' | Honey wine or mead | Úmāli | Eleemali muslum | / Diluted with water | PB | 1 |

Abbreviations: D: Dropsy (Ascites); BD: Useful in bile diarrhea, bilious diarrhea, stop bilious diarrhea; SHS: shrinks the (enlarged) spleen, emaciates the spleen, splenic enlargement, reduces the size of spleen; PBH: Produces bilious humours; EXB: Expels yellow bile; PB: Purged out bile, purges out the 'burnt' bile.

### Minerals

We were able to identify 8 materials of mineral origin (Table 5). The use of such agents in medicine has been well-known throughout history.

### Agents of other origins

Five medicinal agents that were processed from animal or plant materials or agents of mixed or unknown origin are presented in Table 6.

### Table 7. Effective Medicinal agent for liver and spleen diseases grouped based on their origin.

| Origin | Number | Percentage |
|--------|--------|------------|
| Plants | 163    | 84.455     |
| Animals| 17     | 8.81       |
| Minerals| 8      | 4.145      |
| Processed| 5     | 2.59       |
| Sum    | 193    | 100        |
Discussion

The overwhelming majority (84.45%) of agents that served as simple drugs were derived only from plants (see Table 7). The proportion of materials derived from animals and animal organs is small (8.80%), and minerals represent an even smaller proportion (4.14%).

Based on our survey of Canon, 163 herbal parts which exert therapeutic effects on the liver and spleen, were found. In this book, some items refer to one herb Țarfilis and Tıqrıüs both refer to Teukrion or some items are parts of one herb and have different names e.g. RICT is gum and Mahrūth is the root of Anjudhān so the last two have same scientific name of Asafoetida in the Tables.

In old manuscripts, there are different descriptions for identical herb so different scientific names have been proposed for the same herb. Prof. Ghahraman and Prof. Okhovvat have introduced appropriate scientific names for old names; in the present study, we used scientific names according to their suggestions (Ghahraman and Okhovvat, 2004).

From antiquity until now herbalist and medicinal experts had a quest to find the most effective herb that has the richest source of medicinal material, in order to use it in liver tonics and other formulas. Our research revealed that the effective herbs are not limited to one family but the most frequently used herbs belong to several families that are given in Figure 3. Some families like Laminaceae have higher numbers of herbs that are frequently used as effective therapeutics for spleen and liver diseases. We propose to study the herbs of this family and other families noted in Figure 2 in order to find the most effective herb for treatment of liver and spleen diseases.

According to the number of effects that every herb has, as prescribed by Avicenna as effective on liver or spleen diseases or both, the herbs were scored (Figure 2). Ghāfith (Eupatorium cannabinum) was named "The eupatorion of Avicenna" (Tobyn et al., 2016) in old times, is one of the highly scored herbs. The present studies demonstrated choleretic and hepatoprotective effects of hemp agrimony (Lexa et al., 1989) although it contains pyrrolizidine alkaloids (Edgar et al., 1992; Hendriks et al., 1987) which have hepatotoxic and potentially carcinogenic and genotoxic effects and essential oils of E. cannabinum is notably toxic (Judzentiene et al., 2016). On the other hand, the effects of a plant such as Irsā (Iris ensata) which has the highest score (Figure 1), on the liver or spleen, have not yet been reported and its medicinal use had been uncertain or unknown according to lack of articles is considered a good candidate for future investigations. Fūdhanj (Mentha piperita) which also gained a high score was used successfully by Avicenna as a drug, for treatment of liver and spleen diseases. It was shown that M. piperita causes lipid peroxidation and hepatic damage in a dose-dependent manner (Akgoglan et al., 2004). It has hepatotoxic potential (Douros et al., 2016) and moderately severe adverse effects (Posadzki et al., 2013), further studies in this field are needed. Meanwhile, M. piperita has radioprotective properties against gamma irradiation which is probably mediated via its antioxidant and free radical scavenging activities of leaf extract (Samarth et al., 2006); also, this plant may be useful for reducing the side effects of arsenic-induced hepatopathy (Sharma et al., 2007). Afsantin (Artimisia absinthium) is another high-score herb which exhibits hepatoprotective action partly through microsomal drug metabolizing enzymes (MDME) inhibitory action (Gilani and Janbaz, 1995), has significant antioxidant activity and protects the liver and kidney (Kharoubi et al., 2008) probably through its immunomodulatory activity (Amat et al., 2010). Also, this plant was considered for reducing hepatic damage and it may serve as an alternative medicine in hepatic conditions (Saxena and Shukla, 2012).
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These results show a need for a close scrutiny in methods of planting, harvesting, processing, extraction and preparing a single or combination formula that affects remedies and practice of ancient medicine. In order to prepare a suitable herbal drug for the treatment of complicated diseases such as liver cirrhosis and hepatocellular carcinoma, according to Avicenna book, further studies are needed to make an effective drug for liver or spleen diseases is promising.

Through analysis of 806 therapeutic items of Avicenna 2nd volume of Canon, we prepared a list of agents that are effective in three main areas namely, liver, spleen, and liver & spleen diseases. The current study indicates the necessity of deep analysis, study and further assessment of listed items.

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Conflicts of interest
The authors declare that there is no conflict of interest associated with this work.

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