

Review article

Avicenna's Canon of Medicine: a review of analgesics and antiinflammatory substances

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Abstract

Naturally occurring substances mentioned in medieval medical literatures currently have, and will continue to have, a crucial place in drug discovery. Avicenna was a Persian physician who is known as the most influential medical writers in the Middle ages. Avicenna's Canon of Medicine, the most famous books in the history of medicine, presents a clear and organized summary of all the medical knowledge of the time, including a long list of drugs. Several hundred substances and receipts from different sources are mentioned for treatment of different illnesses in this book. The aim of the present study was to provide a descriptive review of all anti-inflammatory and analgesic drugs presented in this comprehensive encyclopedia of medicine. Data for this review were provided by searches of different sections of this book. Long lists of anti-inflammatory and analgesic substances used in the treatment of various diseases are provided. The efficacy of some of these drugs, such as opium, willow oil, curcuma, and garlic, was investigated by modern medicine; pointed to their potent anti-inflammatory and analgesic properties. This review will help further research into the clinical benefits of new drugs for treatment inflammatory of diseases and pain.

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Introduction

Abu Ali al-Husain Ebn Abdullah Ebn Sina (980 –1037 AD), known in the West as Avicenna, was a Persian physician who is known as the most influential medical writers in the medieval period. Between the thirteenth to the seventeenth centuries, Avicenna held a high place in Western medical studies, ranking as an acknowledged supremacy. His works had a crucial impact on the modern medicine and at some universities continued to be used for teaching up to the nineteenth century (Brentjes, 1980; Weisser, 2011).

About 100 dissertations were written by Avicenna. Among them, Qanoon-fel-teb (The Canon), originally written in the Arabic, is an immeasurable encyclopedia of medicine that represents all the medical sciences of the time. The Canon was translated into several languages, including Latin, Persian, English, Indian, Chinese, Hebrew, German, and French (Hakim Syed Zillur Rahman, 2004; Weisser, 2011). The Canon, translated first into Latin (Canon medicinae) by Gerard of Cremona, was the main medical textbook in several universities in Europe between 11th to 17th centuries (Moosavi, 2009). Sir William Osler, one of the four founding professors of Johns Hopkins Hospital, noted the Canon as "the most famous medical textbook ever written; a medical bible for a longer time than any other work" (Osler, 1972).

Avicenna (1988) divided the Canon into five books:

- 1. The first book describes different scope of medicine, the elements, the temperaments, the humors, physiological and anatomical principles, and general therapeutic procedures.
- 2. The second book explains several plant-, animal-, and mineral-derived drugs, in alphabetical order, with an essay on their properties and side-effects.
- 3. The third book describes an organbased classification of the diagnosis and treatment of different diseases.
- 4. The fourth book defines general medical problems that affect the whole body, such as obesity, poisonous bites, and fever.
- 5. The fifth book contains numerous compound receipts.

Eight hundred drugs and 650 recipes of different compounds from various sources are listed in the Canon, with extensive comments on the effectiveness of each drug or recipe (Danielle, 2008). Several clinical and experimental studies support the use of some traditional Persian medicines noted by Avicenna in the Canon for the treatment of different diseases.

However, most medicinal substances prescribed by Avicenna remain largely unexamined (Gorji, 2003). The antiinflammatory and analgesic medicaments are a heterogeneous group of substances, which share definite remedial actions and side effects. The search for new pharmacologically active antiinflammatory and analgesic drugs offered by medieval medical literatures has led to the discovery of some clinically useful drugs. These compounds, during the last two centuries, have played a crucial role as effective remedies of various human diseases as well as in understanding of basic pathophysiology of some diseases (Gorji and Khaleghi Ghadiri, 2001; Gorii and Khaleghi Ghadiri, 2002; Khaleghi Ghadiri and Gorji, 2004; Vakili and Gorji, 2007; Bayan et al., 2013). Despite progress in the development of therapy in recent years, effective and potent antiinflammatory and analgesic drugs are still required for the treatment of different diseases. The aim of the present study was to provide a descriptive review of all antiinflammatory and analgesic drugs noted in the Canon of Avicenna. Data for this review were provided by searches of different sections of this book translated in Persian (Avicenna, 1988). It is hoped that this manuscript will help further research into the clinical benefits of these compounds for treatment of inflammatory diseases.

Anti-inflammatory and analgesic drugs

Avicenna (1988) describes the signs and symptoms (pain, swelling, redness, fever, impaired functions, etc.) of different inflammatorv diseases (such as pneumonia, rhinitis, otitis, dermatitis, etc.) and their treatment with several substances with different modes of action. These drugs were advised to use as prophylactic or therapeutic. Many of these drugs were prescribed for different inflammatory disease, although some of those were advised for a certain disorder. The strategies for treatment of pain and inflammation were divided into the Furthermore, these drugs were classified for treatment of mild, moderate, or severe conditions in each disorder. It is also noted that some of these drugs in certain conditions act as anti-inflammatory of analgesic drugs, in other condition my provoke pain or inflammation. The antiinflammatory and analgesic drugs listed in the Canon include plants, animal products, and minerals. Avicenna emphasized the importance of the dose and the route of administration and defined a schedule for measures of acute and chronic diseases. drug application. Drugs were also taken via skin, oral, nasal, or rectal routes as well as by inhalation (Table).

Some of the medicaments suggested by Avicenna for treatment of inflammation and pain are well-recognized dugs in modern medicine. Many of these compounds are under experimental or clinical investigations for their probable therapeutic effects. However, most of these drugs remain largely unexamined.

Table. Anti-inflammatory and analgesic substances used in medieval Persia by Avicenna and noted in The Canon. AI (Anti-inflammatory); AG (Analgesic).

Latin Name	Common Name	Effect	Administratin	Diseases
Acorus calamus	Sweet flag	AG AI	Oral Locally	Sciatica Headache Toothache Pneumopleuritis Mastitis Eavor
Acorus calamus	Sweet flag	AG	Oral Locally	Muscle pain Sciatica Colic Uterine pain Fever
Adiantum capillus-veneris	Maidenhair	AI	Locally	Pneumonia General edema
Allium ascalonicum	Shallot	AG AI	Oral Locally	Headache Arthritis Otitis
Allium sativum	Garlic	AG AI	Oral Locally	Acute Inflammation Chronic and Malignant Wounds Arthritis and Gout Sciatica Common cold Headache Earache Severe Eye Pain Acute Cough Lung disease with hematemesis Gastroenteritis Liver diseases
Almond oleum	Almond oil	AG AI	Locally	Rhinitis
Alsidium Helminthocorton	Corsican	AG	Oral Locally	Intestinal ulcer Uterine and cervical pain
Althaea officinalis	Marshmallow	AG AI	Locally Oral	Dermatitis Arthralgia Sciatica Earache Toothache Chronic fever

Latin Name	Common Name	Effect	Administration	Diseases
Anacyclus pyrethrum	Pellitory	AG	Oral Locally	Dermatitis Tongue swelling Headache Encephalitis Earache Toothache
Anemon cronaria	Anemone	AG	Oral Locally	Arthritis Neuralgia
Pimpinella anisum	Aniseed	AG AI	Oral Locally	Enteritis Orchitis Sores in nose Tooth pain
Anethum graveolens	Dill	AG AI	Oral Locally	Chronic skin wounds Arthritis and Gout
Apium graveolens	Wild celery	AG AI	Locally Oral	Orchitis Inflammation of the oral Cavity Headache
Aquilaria malaccensis	Aloes	AG AI	Oral Locally	Toothache
Artemisia absinthium	wormwood	AG AI	Oral Locally Inhalation	Otitis Chronic ophthalmitis Chronic fever
Artopa belladona	Nightshade	AG	Locally	General pain Gastroenteritis
Asarum europaeum	Cabaret	AG AI	Oral Locally	Sciatica Chronic ophthalmitis Fever
Asparagus officinalis	Asparagus	AG AI	Oral Locally	Abdominal pain
Asphodelus ramosus	Asphodel	AG AI	Locally	Dermatitis Purulent otitis Gastritis
Avenae fatua	Oat	AI	Oral Locally	Scalp inflammation Eczema
Bambagia	Cotton plant	AG AI	Oral Locally	Earache Sore Throat Cough Chest pain Toothache
Berberis vulgaris	Barberry	AI	Locally	Arthritis
Boswellia serrata	Frankincense	AG AI AG	Oral Locally	Scalp inflammation Arthritis Gout
Brassica oleracea	Cabbage	AI AG	Oral Locally	Dermatitis such as herpes Toothache Cough Bronchitis and shortness of Breath Chest infections Eye pain Dropsy and edema Anal fissure

Table 1.continued

Table 1.continued

Latin Name	Common Name	Effect	Administration	Diseases
Brassica Spp.	Mustard	AG	Locally	Joint and muscle pain
Cannabis Sativa	Hemp	AI	Locally	Ophthalmitis General edema Infectious wounds Gout Uterine pain
Carthamus Tinctorius	Safflower	AG	Oral Locally	Muscle pain Headache Toothache and dental caries Chronic earache Chronic cough and bronchitis Purulent wounds
Carum carvi	Caraway	AI AG	Oral Locally	Edema Arthralgia Muscle discomfort Arthralgia Scalp inflammation
Cheese	-	AG	Oral Locally	Pleuritis Gastrointestinal discomfort
Cassia fistula	Golden shower	AI AG	Oral Locally	General edema Earache Scalp inflammation Joint and bone pain Eye wounds Gastritis
Castor oleum	Castor oil	AI	Oral Locally	Scalp inflammation Chronic headache
Centaurea cyanus	Cornflo-wer	AI AG	Oral	Colic
Chrysanthemum parthenium	Feverfew	AG	Locally	Sciatica
Cicer arietinum	Chana	AI AG	Locally	Eye swelling Hoarseness Bronchitis and cough Stomach pain and gastric ulcer Uterine pain and infection Intestinal ulcer Gastroenteritis Colic
Cichorium intybus	Chicory	AI AG	Oral Locally	Gum disease Gastritis Headaches Earache Eye swelling Intestinal ulcer
Cicuta maculata	Hemlock	AI AG	Oral Locally	Malignant and purulent Wounds Rhinitis Chronic headache Toothache Ophthalmitis

Latin Name	Common Name	Effect	Administration	Diseases
Cocos nucifera	Coconut	AI	Oral	Neck pain
		AG	Locally	Gastrointestinal ulcer Uterine and gum discomfort
Colchicum autumnale	Meadow saffron	AI	Oral	Purulent dermatitis
		AG	Locally	Burn
			·	Chronic wounds
				Sciatica
				Arthralgia
				Toothache
				Headache
ommiphera myrrha	Myrrh	AI AG	Locally	Arthralgia
amminhana ailaa danaia	Delsom of massa	AT	Oral	Diamitia
ommiphora gileadensis	Balsam of mecca	AI	Ural	Pleuritis Headache
		AU	Inhalation	Gastritis
			minatation	Bronchitis
				Kidney pain
				Hemorrhoid
onvolvulus scammonia	scammony	AI	Oral	Gastroenteritis
		AG		
oriandrum sativum	Coriander	AI	Oral	Muscle weakness
ortanar and sativant	Containder	AG	Locally	Artralgia
		110	Locally	Headache
				Purulent otitis
				Bleeding gums and gingivit
				Gastroenteritis
				Hemorrhoid
orvlus aveilana	Common hazel	AI	Oral	General edema
coryius uvenunu	Common nazer	AG	Locally	Hernes
		no	Locally	Accidental injuries
				Muscle pain
				Hiccups
				Gastritis
				Chronic fever
noous satisus	Saffron	AT	Oral	Aguta adama and abagass
iocus suivus	Samoi	AG	Locally	Rone fractures
		10	Locally	Joint and tendon pain
				Headache
				Oral diseases
				Diphtheria
		A T	0.1	
ucurbita pepo	Pumpkin	AI AG	Oral	Genitourinary pain
upressus sempervirens	pencil pine	AI	Locally	Chronic wounds
		AG		Arthralgia Gout
× .				
urcuma longa	Curcuma	AI	Oral	Dermatitis
		AG	Locally	Pain in the mouth and gum
				Scalp wounds
yclamen coum	Sowbread	AG	Locally	Chronic toothache
Symbopagon schoenantus	Sweet rush	AI	Oral	Muscle pain
		AG	Locally	Metritis
			0.1	Cervicitis
ynara cardunculus	Artichoke	AI	Oral	Headache
			Locally	Colic
		AG	Locally	
		AG	Inhalation	Sciatica
		AG	Inhalation	Sciatica Arthralgia

Latin Name	Common Name	Effect	Administration	Diseases
Dausus carota	Carrot	AG	Oral Locally	Kidney and uterine pain Fever
Elettaria cardamomum	Cardamom	AI AG	Oral Locally	Sciatica
Chees Ferment	-	AI AG	Oral Locally	Otitis Cystitis Gastritis Colic Fissure anal
Faba vulgaris	Broad bean	AG	Oral Locally	Diphtheria Ophthalmitis Otitis Abscess Gastrointestinal pain Arthritis
Ferula assafoetida	Stinking gum	AI	Oral	Fever
Ferula gumosa	Galbanum	AI AG	Oral Locally	Headache Gastroenteritis
Ficus carica	Comm-on fig tree	AI AG	Oral	Malignant and purulent Wounds Stomatitis Tooth Pain Gastroenteritis
Foeniculum vulgare	Fennel	AI AG	Oral	Stomatitis Otitis Gastritis
Flores acacia	Acacia	AI AG	Oral Locally Inhalation	Arthritis Chronic eye disease
Fraxinus excelsior	Ash tree	AI AG	Locally	Gout Arthritis
Fumaria perriflora	Fineleaf fumitory	AG	Locally	Earache Back pain Toothache Gingivitis
Gentiana lutea	Gentian	AI	Locally	Abdominal pain
Glycyrrhiza glabra	Liquorice	AI AG	Oral Locally	Skin wounds Scabies Arthralgia Back pain Chronic headache
Hedera helix	Ivy	AI AG	Oral Locally	Skin infections Earache Scalp inflammation
Helleborus niger	Christmas rose	AI AG	Locally	Tonsillitis Arthritis Gout Liver pain

Table 1.continued

Latin Name	Common Name	Effect	Administration	Diseases
Hordeum vulgare	Barley	AI	Oral	Fever
lyssopus officinalis	Hysso	AG	Locally	Eye swelling Otitis Uterine diseases
llicium verum	Anise	AI AG	Oral Locally Inhalation	Dizziness Otitis Headache Chronic ophthalmitis Chronic fever
is florentina	Iris	AI AG	Oral Locally	Toothache Joint contortion
asminum officinale	White jasmin	AI AG	Locally	Painful skin disease Acute mastitis (in pregnancy) Earache Ophthalmitis Eye tumor Uterine pain Gastroenteritis Painful sores in the anal area
uglans regia	Walnut	AG	Oral	Cervical pain General pain
actuca sativa	Lettuce	AI AG	Oral Locally	General edema Joint complaints and gout Sciatica Stomatitis Uterine pain
antago psyllium	Flea wort	AI	Locally	Gingivitis
aureo oleum	Laurel oil	AI	Locally	Joint diseases and gout Ophthalmitis Neck pain Sore throat
avendula stoechas	Spanish lavender	AI AG	Locally	Arthritis Anal fissure
awsonia intermis	Henna	AI AG	Oral Locally	Abscess Purulent scalp inflammation Purulent rashes Sciatica Bronchitis
eidium sativum	Garden cress	AI AG	Oral Locally	Gastrointestinal infections Osteitis Purulent otitis Toothache Intestinal ulcer Hemorrhoids
ens culinaris	Lentil	AI	Oral	Intestinal pain
ignum vite	Grape Tree	AI AG	Oral Locally	Earache Headache
.ilium candidum	Iris	AI AG	Oral Locally	Eye infections Sore throat Pyelonephritis Cystitis Chronic fever

Latin Name	Common Name	Effect	Administration	Diseases
Ialus orientalis	Apple	AI AG	Oral Locally	Acute general edema Muscle pain Abscess Otitis General pain Malignant purulent wounds Toothache Chronic cough and pneumonia Abdominal pain
Marrubium vulgare	Marrubium	AG	Oral Locally	Gastroenteritis Sciatica Arthritis Gout Otitis Mouth wound Gastroenteritis Colic
Matricaria Spp	Camomile	AI AG	Oral Locally	Toothache Muscle tightness
Meliloto officinalis	Field melilot	AI AG	Oral Locally	Otitis Headache Eye swelling
Mentha piperata	Pepper mint	AI AG	Locally Oral	Purulent skin wounds Pneumonia Mastitis
Mentha pulegium	Penny royal	AI AG	Oral Locally	Arthralgia Purulent Malignant sore
Aorus alba	White mulberry	AI AG	Oral Locally	Abscesses and rash Herpes Purulent dermattis Sciatica Malignant sore Toothache Sore throat Chest pain Chronic cough
Ayristica fragrans	Nutmeg	AI	Oral Locally	Arthritis Epilepsy Gout Headache Toothache Cystitis Gastrointestinal pain Cerebrale Kidney pain Arthralgia
Ayrtus communis	Myrtle	AI AG	Oral Locally Inhalation	Testitis Headache Arthritis Otitis Chronic eye disease Gingivitis Cystitis Urinary tract infection Hemorrhoid
Narcissus pseudonarcissus	Lent lily	AI AG	Oral Locally	Headache Hardness tongue Earache Mastitis

Latin Name	Common Name	Effect	Administrati on	Diseases
Nerium oleander	Rosebay	AI	Oral Locally	Acute inflammatory Cervical pain
Nigella sativa	Black cumin	AI AG	Oral Locally	Arthralgia Earache Abdominal pain Hemorrhoids Anal fissures Sores in the genital area
Ocimum basilicum	Basil	AI AG	Oral Locally	Kidney-bladder pain Abscess Headache Toothache Gastritis Hepatitis Menstrual pain Uterine pain Arthralgia Intestinal ulcer Ophthalmitis
Olea europaea	Olive	AI AG	Locally	Gout Acute ophthalmitis Chronic swelling of the diaphragm Liver disease Uterine pain Kidney pain
Oleum lilia	Lilies oil	AI	Locally	Earache Headache Tinnitus Kidney pain Bladder pain Uterine discomfort
Onosma echioides	Hairy onosam	AG	Oral Locally	Stomachache Lumbar pain Liver pain
Opoponax gummi	Opopana-ax Gum	AG	Locally	Pain Sciatic pain
Orchis maculata	Spotted orchis	AG	Oral Locally	Skin diseases Herpes Skin induration Corns Arthritis Tinnitus and hearing loss Headaches Eye diseases Cystitis Gastroenteritis
Origanum majorana	Marjoram	AI AG	Oral Locally	Dermatitis Headaches Ophthalmitis Lung diseases such as bronchitis and chronic cough Uterine pain Chronic fever Toothache Gingivitis Ottije

Table 1.continued

Latin Name	Common Name	Effect	Administration	Diseases
Origanum vulgare	Wild marjoram	AI	Oral	Toothache
		AG	Locally	Swelling of the spleen
Oxalis crenata	Sorrel	AI	Oral	Arthralgia
		AG	Locally	Purulent lung diseases
			,	Blood spitting and coughing
Paeonia officinalis	Common peony	AI	Oral	Toothache
		AG	Locally	Flatulence
				Abdominal pain and fever
Papaver somniferum	Opium poppy	AI	Oral	Arthralgia
- <i></i>	o Form ForFb	AG	Locally	Sciatica
				Gout
				Muscle pain and nerve injury
				Otitis
				Blepharitis
				Urogenital pain
				Abdominal pain
				Uterine pain
				Colic
				Postoperative pain
				Chronic pain
Papavero rosolaccio	Red poppy	AI	Locally	Dermatitis
i aparere resetuccie	rea poppy	AG	Liouniy	Earache
				Eye pain
				Uterine pain
				Orchitis
Parce carduus	Thistle	AI	Oral	Chronic uterine/cervical pain
		AG		I I I I I I I I I I I I I I I I I I I
Pastinaca sativa	Pastinace	AI	Oral	Headache
		AG	Locally	Stomatitis
				Ophthalmitis
				Dermatitis
				Fever
Phonix dactylifera	Date	AI	Locally	Ophthalmitis
		AG		Toothache
Pinus grana	Pine seeds	ΔI	Oral	Abscess
Tinus grana	The secus	AG	Locally	Dental caries
		110	Locally	Toothache
				Spleen diseases
				Uterine disorders
			* 11	
Pinus nuces	Pine cone	AG	Locally	Back muscles vertebrae pain
Pinus silvestris	Pine	AG	Oral	Arthralgia
				Nerve pain
				Back pain
				Muscle complaints
				Abdominal pain and colic
Pinus subvestrie	Scots nine	ΔŢ	Oral	Pleuriti
i nuo syrvestito	Scots pine	AG	Locally	Henatitis
		110	Locuity	Splenitis
				Gastroenteric complain
				Joint and bone pain
				Ophthalmitis

Latin Name	Common Name	Effect	Administration	Diseases
Piper nigrum	Black pepper	AI AG	Oral Locally	Chronic earache
Pistacia vera	Pistachio	AG	Oral Locally	Dermatitis Eliminates the fever Headache
Plantago major	Way-bread	AI AG	Locally	Bone fracture Gout Arthralgia
Platanus orientale	Oriental plane	AI AG	Locally	Knee pain Back pain Toothache General hard edema
Polygonum amphibium	Water knotweed	AI AG	Locally	Lumbar pain
Polypodium vulgare	Adders-fern	AI AG	Oral Locally	Tonsillitis Otitis Arthritis Ophthalmitis Mastitis Chronic cough
Populiferve	Poplar	AI AG	Oral Locally	Headache
Portulaca oleracea	Common purslane	AI AG	Oral Locally	Headache Arthritis Testitis
Pruntus domestica	Plum	AI AG	Oral	Spleen pain General inflammation
Pterocarpus santalinus	Sandal wood	AI AG	Locally	Tooth pain Chronic cough Liver pain
Punica granatum	Pomegranate	AG	Oral	Gastroenteritis (particularly in children) Cervical discomfort Arthralgia Back pain Headaches Earache Colic Dermatitis Ophthalmitis Ocular diseases
Raphanus sativus	Radish	AI AG	Oral	Hepatitis
Recinus	Castrol oil	AI	Locally	General edema Purulent skin wounds Impetigo
Rhabarber rhaponticum	Rheum	AI AG	Oral Locally	Gastritis Gonorrhea Chronic fever
Rhus coriaria	Sicilian sumac	AI AG	Oral	Gastritis Spleen pain Metritis Kidney pain

Latin Name	Common Name	Effect	Administration	Diseases
osa gallica	Red rose	AI AG	Oral	Edema Toothache Earache Breast disease Bronchitis Cough
Rosam	Rose oil	AI AG	Locally	Sciatica and back pain Toothache Headache
Rubus sectio	Bramble	AI	Oral Locally	Arthritis Gout Acute ophthalmitis Mastitis Colitis
Saccharum officinalis	Sugar cane	AI AG	Oral Locally	Gastritis Hepatitis Metritis
Salix	Willow	AI AG	Oral Locally	Osteitis Headache Ophthalmitis Orbital Injury Liver disorders and jaundice Dysmenorrhea
easam indicum	Sesame	AG	Locally	Chronic ocular disease Earache Hemorrhoid
Semecarpod oriente	Marsh nut	AI AG	Locally	Colic Arthralgia
Sesamum indicum	Sesame	AI AG	Oral Locally	Chronic and malignant sore Burn Toothache Earache Mastitis
tyrax officinalis	Styrax tree	AI AG	Oral Locally	Malignant tumors Acute earache Toothache Rash Ophthalmitis Bronchitis Kidney and bladder pain Intestinal ulcer Hemorrhoids Fever
lulfur	Sulfur	AI AG	Oral Locally	Orchitis Ophthalmitis Colic
amarindus indica	Tamarind	AI	Oral Locally	Dermatitis Acute wounds stomach pain Gastroenteritis
'amarix gallica	Tamarisk	AG	Locally	Acute edema Headaches with fever Stomatitis
Faraxacum officinale	Dandelion	AI AG	Locally	Abscess Arthralgia Deep wound Bone wound Dermatitis Headache Purulent ear infections Injury of the orbits

Analgesics and	l anti-inflammatory	drugs	in the	Canon
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Taxus baccate	Yew tree	AI	0.1	
			Oral Locally	Sciatic pain Arthritis and gout Dental pain and dental caries Headaches Ear Diseases Gum bleeding and gingivitis
Tragopogon pratensis	Meadow salsify	AI AG	Locally	Wounds and nerve damage Muscleaches Gastroenteritis
Frigonella foenum-graecum	Alhova	AI AG	Oral Locally	Sciatic pain Arthralgia
Tropaeolum majus	Monks cress	AI AG	Oral Locally	Sore throat Arthralgia
Urtica dioica	Nettle	AI AG	Oral Locally	Gout Headache Otitis Ophthalmitis Diarrhea Colic Chronic pain
Valeriana officinalis	Valerian	AI AG	Oral Locally	Headache Inflammation of the penis Ophthalmitis
Verbascum thapsiforme	Mullein	AI AG	Locally	Rhinitis Sinusitis Otitis Orchitis Ophthalmitis
Vicia sativa	Tare	AG	Locally	Burn Arthralgia Headache Uterine pain
Vinegar	Ċ	AG AI	Oral Locally	Herpes Purulent skin wounds Gout Headache Gingivitis
Viola odorata	Sweet violet	AI AG	Locally	Headache Cold
Vitex agnus-castus	Chasteberry	AG	Oral Locally	Pain Colic
Vitis vinifera	Grape vine	AG	Oral Locally	Gasteritis Uterine pain Abdominal pain Kidney and bladder pain
Zingiber officinale	Ginger	AI AG	Oral Locally	Headache General pain

Well recognized anti-inflammatory and analgesic drugs

Papaver somniferum

Opium (Papaver somniferum) was advised for treatment of arthralgia,

sciatica, gout, muscle pain and nerve injury, otitis, blepharitis, urogenital pain, abdominal pain, uterine pain, colic, postoperative pain, and chronic pain in the Canon. In 1680, Sydenham was noted opium: "Among the remedies which it has pleased Almighty God to give to man to relieve his sufferings, none is so universal and so efficacious as opium" (Yaksh and Wallace, 2011).

Administration of opiate in Europe increased rapidly in the 18th century (Miller and Tran, 2000). Opium and its derivatives have been used as the most widely analgesics for severe pain since the early 1800s (Hamilton and Baskett, 2000). Nowadays, application of several opioids is considered effective for the treatment of various forms of headaches (Gorii and Khaleghi Ghadiri 2001), postoperative pain (Hamilton and Baskett, 2000), neuropathic pain (Berrios et al., 2008), and different chronic pain syndromes (Vallejo et al., 2011). Opium also plays a crucial role in our understanding of basic mechanism of pain (Lipman, 1990).

Salix spp.

In the Canon, administration of willow oil (Salix spp.) was recommended for treatment of headache. osteitis. ophthalmitis, orbital injury, liver disorders and jaundice, and dysmenorrhea. In the first half of the 19th century salicin, the principal active constituent of willow oil was extracted from the willow bark and later salicylic acid was obtained. Today, the synthetically produced preparations of salicylic acid are well-known analgesic, anti-inflammatory and antipyretic drug (Amann and Peskar, 2002).

Acetylsalicylic acid is recommended as an analgesic and prophylactic in different types of headaches [4], and alleviates dysmenorrhea (Pendergrass et al., 1985). Furthermore, it has been suggested that regular aspirin use (more than 15 times per month) may be associated with a lower prevalence of non-alcoholic fatty liver disease among men and older patients (Shen et al., 2014).

Curcuma longa

Curcuma (*Curcuma longa*) is advised for treatment of different inflammatory

diseases and pain in the Canon. Promising effects of curcuma have been reported in patients with various pro-inflammatory diseases, including oncologic disorders, cardiovascular disease, rheumatologic uveitis. diseases. chronic anterior gastrointestinal inflammatory diseases (Crohn's disease, ulcerative proctitis and colitis, irritable bowel disease, pancreatitis, gastric inflammation as well as ulcer, and cholecystitis), lupus nephritis, ischemic brain injuries. and acquired immunodeficiency syndrome (Gupta et al., 2013; Tamaddonfard, 2013; Arshami et al., 2013; Ghosh et al., 2014).

Cannabis sativa

Cannabis (Cannabis sativa) was prescribed for the alleviation of severe headache as well as treatment for degenerative bone and joint diseases, ophthalmitis, general edema, infectious wounds, gout, and uterine pain. The major active component of cannabis. tetrahydrocannabinols, in addition to other constituents of cannabis has been shown to possess anti-nociceptive properties (Wilson and Nicoll, 2002).

Cannabinoids alleviate pain by the activation of a brainstem circuit that is required for opioid-mediated analgesia, and modulate basal nociceptive thresholds through the activation of the rostral ventromedial medulla [8]. It has been suggested that cannabinoids may act as an analgesic in migraine pain by inhibition of depression phenomenon spreading (Kazemi et al., 2012). Different constituents of cannabis have been suggested to be useful in the treatment of intervertebral disc degeneration (Silveira et al., 2014), endometriosis (Sanchez et al., 2012), and breast cancer (Behrend, 2013). Cannabis has been suggested to be used to treat patients with cancer who do not adequately treated with other analgesics and anti-emetics (Nauck et al., 2004).

Allium sativum

Garlic (Allium sativum) was recommended by Avicenna in his book for treatment of acute inflammation, chronic and malignant wounds, arthritis and gout, sciatica, common cold, headache, earache, severe eye pain, acute cough, lung disease with hematemesis, gastroenteritis, and liver diseases. Anti-inflammatory effect is a well-known property of this plant. Garlic and its bioactive components protect the hepatocytes from several toxic agents and act as antimicrobial, antifungal, and antiviral substances (Bayan et al., 2014). Diallyl disulfide, a major organosulfur compound in garlic oil, has been shown to a useful substance in treatment of respiratory inflammation (Shin et al., 2013). Administration of garlic have been suggested for treatment of common cold (Allan and Arroll, 2014), arterial occlusive disease (Jepson et al., 2013), migraine headache (Roussos and Hirsch, 2014; Marschollek et al., 2014), and prevention of different tumors (Bayan et al., 2014).

Medicaments under investigation for their probable anti-inflammatory and analgesic effects

Matricaria chamomilla

Avicenna advised to use chamomile (Matricaria chamomilla) for treatment of headache, edema, conjunctivitis, jaundice, lithiasis, fever. chronic amenorrhea. toothache. and muscle tightness. Chamomile is recommended to relieve itching and inflammation and facilitate healing of peristomal skin lesions in patients undergone the gastrointestinal or urinary surgeries (Charousaei et al., 2011).

The fluid extract from chamomile reduced pain of aphthous ulcers in patients suffering from recurrent aphthous stomatitis (Ramos-e-Silva et al., 2006). It is hypothesized that chamomile flavonoids polyphenols due to its and antiinflammatory properties via the inhibition of pro-inflammatory biomarkers in macrophages, inhibition of endogenous prostaglandin E2 levels, and reduction of nitric oxide values may alleviate migraine pain (Zargaran et al., 2014). Chamomile modulates phase I and phase II drug enzymes metabolizing in the liver (Maliakal and Wanwimolruk, 2001), improves endometrial tissue arrangements (Farideh et al., 2010), and alleviate pain edema present in various and inflammatory conditions (Tomić et al., 2014) in animal experiments. The antiinflammatory effect of chamomile is suggested to be mainly due its essential oils, such as bisabololand, chamazulene and matricin, possibly via inhibition of histamine release and the production of prostaglandin (Safayhi et al., 1994; Miller et al., 1996; Srivastava et al., 2010).

Malus orientalis

Apple (Malus orientalis) is advised for treatment of acute general edema, muscle pain, abscess, otitis, purulent wounds, toothache, chronic cough and pneumonia, abdominal pain. and intestinal inflammation as well as for prevention of headache by Avicenna. The apple contains polyphenols with a large variability in their structures, which are stored in vacuoles and chromoplasts (Francini and Sebastiani, Antioxidant 2013). reactions of phytochemicals inhibit the oxidation of harmful substances and act as radical catcher. Reactive oxygen species are noxious in a large amount and cause cell damage by reaction with lipids, proteins and deoxyribonucleic acid (Mladenka et al., 2010). Secondary plant metabolites and polyphenols have anti-inflammatory, anticarcinogenic, anti-microbial, anti-oxidant, and anti-thrombotic effects (Scalbert et al., 2005; Jelodarian et al., 2013). Apple polysaccharide extract is suggested to prevent colitis-associated colon cancer via the inhibition of TLR4/MD2-mediated signaling and the inhibition of NF-kBmediated inflammatory signaling pathways (Zhang et al., 2015). Apple flavonols in combination with fish oil inhibited the production of pro-inflammatory mediators and significantly improved blood lipid profiles in rats with diet-induced hyperlipidemia and lipopolysaccharideinduced acute inflammation (Sekhon-Loodu et al., 2014).

High-flavonoid apple was associated with decreases in the transcription levels of inflammation-linked genes for interleukin-2 receptor, chemokine receptor 2, chemokine ligand 10, and chemokine receptor 10 as well as in production of prostaglandin E2 (Espley et al., 2014).

Boswellia serrata

medieval Persian, frankincense In (Boswellia serrata) was advised for abscess, treatment of wounds and malignant tumors, skin rashes, dermatitis, nausea and vomiting, gastrointestinal inflammation, and arthritis. Several experimental studies have shown that frankincense possesses anti-inflammatory, analgesic, antimicrobial, hepatoactive, and anti-proliferative effect (Abdel-Tawab et al., 2011).

The resinous part of *Boswellia serrata* anti-inflammatory possesses several substances, including mono-, di-, tri-, major pentacyclic and four tetra-, triterpenic acids (Siddiqui, 2011). Oral administration of Boswellia serrata gum resin extract significantly reduced the levels of several inflammatory mediators (interleukins 1β and β , tumor necrosis Interferon factor- α . gamma. and prostaglandin E2). and increased interleukin-10.

The protective effect of frankincense against rheumatoid arthritis is suggested evident due to the decrease in arthritis scoring and bone histology in a collagen induced arthritis model in rats (Umar et al., 2014). Aflapin, a novel Boswellia-derived anti-inflammatory product, significantly inhibited interleukins 1β-induced death of chondrocytes human primary and improves production of glycosaminoglycan in human chondrocytes (Sengupta et al., 2011).

Cinnamomum camphora

Camphor (*Cinnamonum camphora*) is advised for treatment of headache and arthralgia as well as against inflammation in different organs. Camphor inhibited heat-sensitive transient receptor potential vanilloid subtype 1 (TRPV1) and several other related channels, which may underlie the analgesic effects of camphor (Xu et al., 2005). Camphor activated cultured primary keratinocytes (contained heat-activated receptors), and this effect was abolished in TRPV3 null mice (Moqrich et al., 2005).

Phytochemical investigation of Myrrh (*Commiphera myrrha*) has resulted in identification of more than 300 secondary metabolites which have exhibited a wide-range of pharmacological properties that are effective in treatment of inflammatory and infection diseases.

The bioactive steroids guggulsterones have been suggested as a potent inhibitory component on tumor cells and inflammation (Shen et al., 2012). Lavender (Lavendula stoechas) is believed to have a variety of therapeutic and curative properties in the Canon. In a placebocontrolled clinical trial, inhalation of lavender oil was suggested as an effective and safe treatment in acute management of migraine attacks (Sasannejad et al., 2012). Lavender inhibited some inflammatory processes, such as lipopolysaccharideinduced inflammatory reaction (Koulivand et al., 2013).

Ethanolic and aqueous extracts of saffron (*Crocus sativus*), another analgesic and anti-inflammatory drug mentioned in the Canon, have been suggested as a useful substances in treatment of different kinds of neuropathic pain and acetaminophen toxicity (Amin and Hosseinzadeh, 2012; Omidi et al., 2014.

Several strategies have been used for development of new drugs. One of these strategies is the use, development and improvement of existing medicines, like natural healing substances, which have been used long to treat the illnesses in traditional medicine. Although some of anti-inflammatory and analgesic substances advised by Avicenna in the Canon are used by modern medicine, the exact mechanism of their action as well as biochemical and pharmacological values needs more investigations. Several other drugs are still unexamined, which have the potential for further investigations and discovery of new drugs against inflammatory diseases and pain.

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Conflict of interest

The Authors declare that there is no conflict of interest.

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