Research paper

Critical Analysis of Animal-Derived Products in Traditional Indian Medicine: Special Focus on the Unani System of Medicine

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ABSTRACT

Animal-derived medicinal substances constitute an important yet relatively understudied component of traditional medical systems. In the Unani system of medicine, numerous materials obtained from insects, marine organisms, mammals, reptiles, and birds have historically been used for therapeutic purposes. The present review critically evaluates animal-derived drugs described in classical Unani literature and examines their ethno-pharmacological relevance, pharmacological evidence, and sustainability concerns. A structured literature search was conducted using major scientific databases including PubMed, Web of Science, ScienceDirect, and Google Scholar in accordance with PRISMA-based reporting principles. Classical Unani texts such as Unani Advia Mufarrada by Hk. Syed. Safiuddin Ali, Bustanul Mufarradat Jadeed by Hk. Mohd. Abdul Hakeem, Tajul Mufarradat by Dr. wo Hakeem Naseer Ahmed Tariq were also examined to identify traditional animal-derived medicinal substances. Forty-Eight (48) animal-derived drugs were documented and analyzed with respect to biological origin, traditional therapeutic actions, bioactive compounds, and available scientific evidence. Many of these materials contain pharmacologically active molecules including peptides, enzymes, fatty acids, sterols, and mineral complexes that exhibit antimicrobial, anti-inflammatory, cardio-protective, neuro-protective, and wound-healing properties. However, limited clinical validation, lack of standardization, and biodiversity conservation concerns remain significant challenges for their integration into modern therapeutics. The findings highlight the importance of interdisciplinary research combining ethno-pharmacology, pharmacology, and conservation science to explore the therapeutic potential of animal-derived medicinal resources while ensuring sustainable utilization.

Keywords: Unani medicine; Zoo-therapy; Animal-derived drugs; Ethno-pharmacology; Bio-diversity conservation; Traditional medicine.

How to cite this article: Waheed MA, Manzar Alam M, Akhter Hussain Jamali M, Najeeb Khan M, Touheed Ahmad S, Akhtar J, Zaheer Ahmed N. Critical Analysis of Animal-Derived Products in Traditional Indian Medicine: Special Focus on the Unani System of Medicine. Int J Drug Deliv Technol. 2026;16(51s): 1706-1723.
DOI: 10.25258/ijddt.16.51s.132

Source of support: Nil.
Conflict of interest: None.

1. Introduction:

Traditional medicine remains an integral component of healthcare in many parts of the world. The World Health Organization estimates that approximately 80% of the global population relies on traditional medicinal practices for primary healthcare needs. These medical systems frequently utilize natural products derived from plants, minerals, and animals, which serve as valuable sources of therapeutic agents in ethno-medicine.

India possesses remarkable biological diversity and a long history of traditional medical knowledge. Among the recognized traditional medical systems practiced in the country, the Unani system of medicine occupies a prominent position. Originating from Greco-Arab medical traditions and later enriched by Persian and Indian scholarship, Unani medicine employs a holistic therapeutic approach involving Dieto-therapy, Pharmaco-therapy, and Regimenal therapies.

Animal-derived medicinal substances constitute an important component of the Unani materia medica. Classical texts such as *Al-Qānūn fi'l-Ṭibb* and *Khazain-ul-Advia* describe numerous animal-based materials including musk, ambergris, pearl, coral, honey, and beeswax. These substances are traditionally believed to possess therapeutic properties such as cardio-tonic, neuro-protective, anti-inflammatory, and antimicrobial activities.

Modern scientific studies have demonstrated that many animal-derived products contain bioactive molecules including peptides, enzymes, fatty acids, and mineral complexes that may contribute to these pharmacological effects. For example, honey and bee-derived products exhibit antimicrobial and wound-healing activities, while marine-derived substances such as fish oil have demonstrated cardio-protective properties due to the presence of omega-3 fatty acids.

Despite centuries of traditional use, many of these substances have not been comprehensively evaluated using modern pharmacological approaches. Furthermore, concerns related to wildlife conservation, ethical sourcing, and regulatory standardization have raised important questions regarding the sustainability of zoo-therapeutic practices.

Therefore, the present review aims to critically analyze animal-derived medicinal substances used in the Unani system with emphasis on their ethno-pharmacological significance, pharmacological evidence, and conservation implications.

2. Materials and Methods:

2.1 Literature Search Strategy

A comprehensive literature search was conducted to identify relevant information on animal-derived medicinal substances used in the Unani system of medicine. Classical Unani texts including *Unani Advia Mufarrada*, *Bustanul Mufarradat Jadeed* and *Tajul Mufarradat* were examined to identify traditional animal-derived drugs and their therapeutic applications.

Electronic databases including PubMed, Web of Science, ScienceDirect, and Google Scholar were searched for relevant scientific literature published up to December 2025. The review process was conducted following internationally accepted reporting principles for systematic reviews.

The search was performed using combinations of the following keywords: animal-derived drugs, zoo-therapy, Unani medicine, ethno-pharmacology, traditional medicine.

The Boolean search strategy used was:
("animal-derived drugs" OR "zootherapy") AND ("Unani medicine" OR "traditional medicine")

The retrieved articles were screened based on title, abstract, and full-text evaluation to identify studies describing animal-derived medicinal substances, their pharmacological activities, and ethno-pharmacological relevance.

2.2 PRISMA-Based Study Selection

The study selection process was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency and reproducibility of the literature screening procedure. All records retrieved from electronic database searches were initially screened based on their titles and abstracts to identify potentially relevant studies. Duplicate records identified across multiple databases were removed prior to further screening.

Subsequently, the remaining articles were subjected to full-text evaluation to assess their eligibility for inclusion in the review. Studies were included if they reported information related to animal-derived medicinal substances used in traditional medicine, particularly within the Unani system, and provided ethno-pharmacological, pharmacological, or biochemical evidence supporting their therapeutic applications.

Studies that did not address animal-derived medicinal products, lacked sufficient scientific information, or represented duplicate or inaccessible publications were excluded from the final analysis. The overall study selection process is summarized in the PRISMA flow diagram presented in Figure….

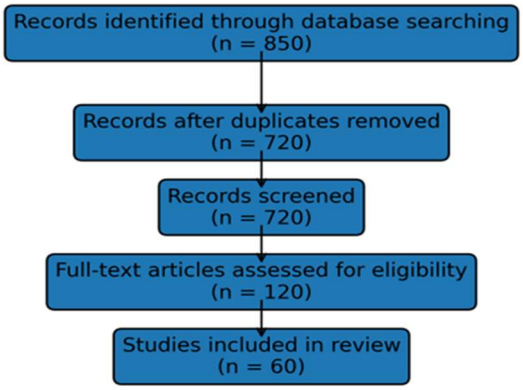

Figure 1. PRISMA-2020 flow diagram showing the literature identification, screening, eligibility assessment, and final inclusion of studies evaluating animal-derived medicinal substances used in the Unani system of medicine.

2.3. Inclusion Criteria

Studies were included in the review if they reported the use of animal-derived medicinal substances in traditional medical systems, particularly within the Unani system of medicine or related ethno-medical traditions. Eligible studies provided ethno-pharmacological descriptions, pharmacological investigations, or biochemical evidence supporting the therapeutic applications of these animal-derived materials. Both experimental and review studies that contributed relevant information regarding the traditional uses, pharmacological activities, or bioactive constituents of animal-derived drugs were considered. Only publications available in full-text

form and written in English were included in the analysis.

2.4. Exclusion Criteria

Studies were excluded from the review if they were unrelated to traditional medicine or did not address animal-derived medicinal substances. Articles lacking sufficient ethno-pharmacological, pharmacological, or biochemical evidence regarding the therapeutic use of animal-derived materials were also excluded. In addition, duplicate publications identified across multiple databases were removed during the screening process. Studies that were unavailable in full text or did not provide adequate information relevant to the objectives of the present review were not considered for inclusion.

3. Results:

Diversity of Animal-Derived Drugs

Forty Eight (48) animal-derived medicinal substances were identified from classical Unani literature and pharmacopoeial sources.

These substances originate from several biological groups including:

Category	Examples
Mammals	Musk, deer antler
Marine organisms	Coral, pearl
Insects	Lac, beeswax
Reptiles	Sand fish
Arthropods	Scorpion venom
Birds	Egg products

Table 1. Animal-derived drugs used in the Unani system of medicine showing biological source, traditional pharmacological actions (Afʿāl), major bioactive compounds, pharmacological activities, and available evidence levels.

S. No	Unani Drug	Biological Source (Scientific Name)	Part Used	Major Unani Actions (Afʿāl)	Key Bioactive Compounds	Pharmacological Activities	Evidence Level	Ref
1	Abresham (Silk Pod)	*Bombyx mori*	Cocoon	Muqawwi Qalb, Muqawwi Asab	Fibroin, Sericin	Antioxidant, cardio-protective	In-vitro	1

2	Amber (Ambergris)	*Physeter macrocephalus*	Ambergris	Mufarreh and Muqawwi Qalb-wo-Dimagh	Ambrein	Neuro-protective	Traditional	2
S. No	**Unani Drug**	**Biological Source (Scientific Name)**	**Part Used**	**Major Unani Actions (Afʿāl)**	**Key Bioactive Compounds**	**Pharmacological Activities**	**Evidence Level**	**Ref**
3	Ankabooth, (Kartabah), (Cobweb), (Makdi)	*Parastea toda tepidario rum*	Cobweb	Habis-ud-Dum	Vitamin-K	Heamostatic	Traditional	3
4	Aqrab (Scorpion), (Bichoo)	*Buthus occitanus*	Whole animal	Dafiʿ Samoom	Scorpion Peptides	Analgesic, anticancer	In-vitro, In-vivo	4
5	Birbahuti (Red Velvet Mite)	*Trombidium grandissimum*	Whole insect	Muqawwi Bah	Carotenoids	Aphrodisiac	Traditional	5
6	Charbi-e-Bakri	*Capra hircus*	Fat	Muhallil	Lipids	Anti-inflammatory	Traditional	6
7	Charbi-e-Bher	*Ovis aries*	Fat	Mulattif	Fatty acids	Anti-inflammatory	Traditional	7
8	Charbi-e-Machhli	*Fish*	Fat	Muqawwi Dimagh	Omega-3	Cardio-protective	Clinical	8
9	Charbi-e-Murgh	*Chicken*	Fat	Mulattif	Fatty acids	Anti-inflammatory	Traditional	9
10	Dandan-	*Elephas ma*	Ivory	Muqaw	Calcium Phosphate	Mineral sup	Traditio	10

	e-Fil (Haathi Daanth), (Elephant Tusk)	*ximus*		wi Badan		plement	nal	
11	Jonk (Alaq), (Leech)	*Hirudomedicinalis*	Whole animal	Musaffi Dam	Hirudin	Anticoagulant	Clinical	11
12	Jugnu (Fire Fly)	*Lampyridae sp p.*	Whole insect	Muqawwi Asab	Luciferin	Antioxidant	Traditional	12
13	Jund-be-Dastar (Castoreum)	*Castor fiber*	Castoreum	Muqawwi Dimagh	Phenolics	Anti-inflammatory	Traditional	13
14	Kaf-e-Dariya (Zubd-ul-Bahr), (Samandar Jhag), (Cuttlefish Bone)	*Marine sponge sp p.*	Whole sponge	Muhallil	Sterols	Antimicrobial	In-vitro	14
15	Kaf-e-Mahi	*Fish foam*	Secretion	Mulattif	Proteins	Anti-inflammatory	Traditional	15
16	Kharateen (Kenchwa), (Earthworm)	*Lumbricus terrestris*	Whole worm	Muqawwi Bah, Muhallil Varm	Lumbrokinase	Anti-thrombotic	In-vitro, In-vivo	16
17	Kharmohra	*Coral sp p.*	Skeleton	Dafi' Tashannuj	Calcium Salts	Antacid	Traditional	17
18	Kirm-e-Abr	*Bombyx mori*	Larva	Muqawwi	Proteins	Immuno-modul	In-vitro	18

	esham			Badan		atory		
19	Lak	*Kerria lacca*	Shellac (Resin)	Dafiʿ Nazf	Shellolic Acid	Anti-inflammatory	Traditional	19
20	Maghz-e-Kanjshak (Maghz-e-Asfoor), (Sparrow Brain)	*Passer domesticus*	Brain	Muqawwi-Bah, Mualli-e-Mani	Sialylated Mucin Glycopeptides, Amino Acids	Support Brain Health, Neuro-protection, and Cognitive Function	Traditional	20
21	Mahi Rubiyan (Jhinga), (Prawn)	*Palaemon curtinus*	Flesh	Muqawwi-e-Bah, Mualli-e-M	astaxanthin, chitin / chitosan bioactive peptides	Potent Antioxidant, Antimicrobial/Antioxidant	Traditional	21

				ani				
22	Mahi-e-Samundari	*Marine fish*	Flesh	Muqawwi Badan	Omega-3	Cardio-protective	Clinical	22
S. No	**Unani Drug**	**Biological Source (Scientific Name)**	**Part Used**	**Major Unani Actions (Afʿāl)**	**Key Bioactive Compounds**	**Pharmacological Activities**	**Evidence Level**	**Ref**
23	Marjan (Coral)	*Coralium rubrum*	Coral	Muqawwi Qalb	Calcium Carbonate	Antacid	Traditional	23
24	Marwareed (Mothi), (Pearl)	*Pinctada margaritifera*	Pearl	Muqawwi Qalb	Conchiolin	Antioxidant	In-vitro	24
25	Mirarat-ul-Baqr	*Bos taurus*	Gall Bladd	Muhallil-e-Aur	Cholic Acid, Deoxycholic Acid, and Chenodeoxycholic Acid	Anti-Inflammatory,	Traditional	25

	(Zehr-e-Gao), (Cow Gall Bladder)		der	am		Hepato-protective and Sedating		
26	Misk (Musk)	*Moschus moschiferus*	Musk gland	Muqawwi Qalb	Muscone	Cardio-protective	Traditional	26
27	Mom Zard (Beeswax)	*Apis mellifera*	Beeswax	Mudammil	Esters	Wound healing	Traditional	27
28	Nuaam (Shutar Murgh), (Ostrich)	*Struthio camelus*	Flesh	Kasir-e-Riyah, Munzj-e-Balgham	Anserine, Glutathione	Anti-Inflammatory and Potential Anti-Aging, Antioxidant	Traditional	28
29	Qaran-ul-Ail (Deer Horn)	*phus*	orn	wo-Musakkin		tective	vo	
30	Qarn-ul-Baqr (Shakh-e-Gao), (Cow Horns), (Gaike Seeng)	*Bos taurus*	Horn	Habis-ud-Dum, Muhallil	Keratin, Arginine, Alanine, Aspartic Acid, Leucine, and Cholesterol	Anti-Inflammatory	Traditional	30
31	Reg-e-Mahi (Samak al-Ramal), (Sand Fi	*Scincus scincus*	Whole Lizard	Muqawwi Bah	Zinc, Tocopherol (Vit.E)	Aphrodisiac	Traditional	31

	sh)							
32	Rohu (Shaboth), (Rohu Fish)	*Labeo rohita*	Flesh	Muqawwi-e-Dimagh-wo-Bah	omega-3/omega-6 fatty acids, and essential amino acids	Antioxidant and Antimicrobial	Traditional	32
33	Sadaf (Oyster Shell)	*Pinctada spp.*	Shell	Muqawwi Asab	Calcium carbonate	Antacid	Traditional	33
34	Samak (Mahi), (Machli), (Fish)	*Fish spp.*	Flesh	Muqawwi Badan	Omega-3	Cardio-protective	Clinical	34
35	Sangdana-e-Murgh (Hen Gizzard)	*Gastrolith*	Gizzard	Muqawwi Meda-wo-Jigar	Minerals	Stomach and Liver Tonic	Traditional	35
36	Sang-e-Sarmahi	*Fish otolith*	Otolith	Mudire Boul-wo-Mufatte Hisathe Kulliya-wo-Masana	Calcium Salts	Diuretic and Lithotripsic	Traditional	36
37	Sareesh Mahi	*Fish glue*	Collagen extract	Mundammil	Collagen Peptides	Tissue repair	In-vitro	37
S. No	**Unani Drug**	**Biological Source (Scientific Name)**	**Part Used**	**Major Unani Actions (Afʿāl)**	**Key Bioactive Compounds**	**Pharmacological Activities**	**Evidence Level**	**Ref**
38	Sartan (Crab)	*Cancer pagurus*	Whole animal	Muqawwi B	Chitin	Immuno-modul	In-vitro	38

			mal	adan		atory		
39	Shahed (Asl), (Honey)	*Apis mellifera*	Honey	Mulattif	Flavonoids	Antimicrobial	Clinical	39
40	Shakar-e-Tighal (Treha la Manna)	*Insect secretion*	Resin	Dafe Suaal	Sugars	Anti-Tussive	Traditional	40
41	Singhi Machli (Aqrab-e-Behri), (Asian stinging catfish)	*Heteropneustes fossilis*	Gall Bladder	Daf-e-Amraz-e-Chashm	proteins, iron, omega-3 fatty acids	Anti-Inflammatory, Antimicrobial, and Regenerative Properties	Traditional	41
42	Sufaid-e-Baize Murgh (Egg White)	*Gallus gallus*	Egg w hite	Mudam il	Albumin	Wound healing	In-vitro	42
43	Saqanqor (Eastern Skink)	*Scincus Mitranus*	Whole lizard	Muqawwi Bah	Steroids	Aphrodisiac	Traditional	43
44	Tawus (Peacock), (Mor)	*Pavo cristatus*	Flesh, Feather	Flesh-Muqawwi-e-Meda-wo-Bah, Burnt Feathers-Useful in Hiccups	Flesh-Protein and Amino Acids, Feather-Keratin, Melanin	Antioxidant	Traditional	44

45	Zarareeh (Spanish Fly)	*Lytta vesicatoria*	Whole insect	Muhallil	Cantharidin	Anticancer	In-vitro	45
46	Zard-e-Baize Murgh (Egg Yolk)	*Gallus gallus*	Egg yolk	Muqawwi Badan	Lecithin	Neuro-protective	In-vitro	46
47	Zehar-e-Aqrab (Scorpion Venom)	*Scorpion*	Venom	Dafi' Samoom	Venom peptides	Analgesic	In-vitro	47
48	Zehar-e-Nahal (Honey Bee Venom)	*Apis mellifera*	Bee venom	Muhallil	Melittin	Anti-inflammatory	Clinical	48

4. Pharmacological Mechanisms:

Animal-derived medicinal substances contain a wide range of bioactive molecules, including peptides, enzymes, sterols, fatty acids, and mineral complexes. These compounds exert diverse pharmacological activities through multiple molecular mechanisms that influence inflammatory pathways, microbial growth, metabolic regulation, and neuronal signaling. Increasing pharmacological evidence suggests that many animal-derived natural products interact with specific cellular targets, thereby contributing to their therapeutic effects.

4.1. Antimicrobial Mechanisms

Several animal-derived peptides exhibit antimicrobial activity by disrupting microbial cell membranes and interfering with intracellular metabolic processes. For example, melittin, a major component of bee venom, interacts with phospholipid membranes and forms pores that lead to microbial cell lysis. In addition, honey-derived compounds have been shown to inhibit bacterial growth through osmotic effects, hydrogen peroxide production, and phenolic compounds.

4.2. Anti-inflammatory Mechanisms

Animal-derived bioactive compounds can modulate inflammatory signaling pathways by inhibiting the production of inflammatory mediators such as prostaglandins, cytokines, and nitric oxide. Venom-derived peptides and fatty acids have demonstrated the ability to suppress nuclear factor-κB (NF-κB) signaling and reduce the expression of pro-inflammatory cytokines, thereby contributing to their anti-inflammatory effects.

4.3. Cardio-protective Mechanisms

Marine-derived lipids, particularly omega-3 polyunsaturated fatty acids such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), play an important role in cardiovascular protection. These compounds regulate lipid metabolism, reduce triglyceride levels, improve endothelial function, and suppress inflammatory responses associated with cardiovascular disease.

4.4. Neuro-protective Mechanisms

Certain animal-derived compounds exhibit neuro-protective properties by modulating neuronal signaling pathways and improving cerebral circulation. For instance, muscone, a bioactive component derived from musk, has been reported to enhance cerebral blood flow and protect neuronal cells from oxidative stress. Such mechanisms may contribute to the traditional use of musk in

neurological disorders described in classical Unani medicine.

4.5. Wound-Healing Mechanisms

Animal-derived medicinal substances have been traditionally used in wound management due to their antimicrobial, anti-inflammatory, and tissue-regenerative properties. Several bioactive compounds derived from animal sources promote wound healing by modulating multiple stages of the healing process, including inflammation, cellular proliferation, and tissue remodeling. These substances often contain peptides, enzymes, and fatty acids that facilitate tissue repair and protect the wound environment from microbial infection.

Honey is one of the most extensively studied animal-derived substances for wound healing. Its therapeutic effects are attributed to several mechanisms, including antimicrobial activity, osmotic action, and the presence of hydrogen peroxide and phenolic compounds that inhibit microbial growth and promote tissue regeneration. In addition, honey has been shown to stimulate fibroblast proliferation, collagen synthesis, and angiogenesis, all of which are essential processes in wound repair.

Marine-derived collagen peptides have also demonstrated significant wound-healing potential. Collagen serves as a structural component of the extracellular matrix and plays a critical role in tissue regeneration and cellular migration during wound repair. Experimental studies have shown that marine collagen peptides can enhance fibroblast activity and accelerate wound closure through stimulation of extracellular matrix synthesis and growth factor signaling pathways.

Similarly, beeswax and other animal-derived lipids contribute to wound healing by forming protective barriers that maintain moisture at the wound site and support epithelial regeneration. These substances may also reduce local inflammation and enhance the formation of new tissue during the healing process.

Overall, the wound-healing properties of animal-derived medicinal substances are mediated through a combination of antimicrobial protection, modulation of inflammatory responses, stimulation of cellular proliferation, and enhancement of extracellular matrix formation. These mechanisms support the traditional use of such materials in Unani medicine and highlight their potential for the development of modern therapeutic formulations for wound management.

5. Discussion:

Animal-derived medicinal substances represent a unique and historically significant component of traditional pharmacotherapy. In the Unani system of medicine, these materials have been employed for centuries to treat a wide range of diseases. Classical Unani literature describes numerous animal-based medicinal materials that have historically been incorporated into therapeutic formulations and pharmacological preparations. The present review highlights the remarkable diversity of animal-derived drugs documented in classical Unani texts and examines their potential pharmacological relevance within modern biomedical research.

Modern scientific investigations have begun to validate several traditional claims associated with these substances. Bioactive compounds such as peptides, enzymes, fatty acids, and sterols have demonstrated antimicrobial, anti-inflammatory, cardio-protective, and neuro-protective properties in experimental studies. For instance, antimicrobial peptides derived from animal venoms and bee products have been shown to disrupt microbial membranes and inhibit pathogenic microorganisms. Similarly, omega-3 fatty acids obtained from marine organisms exhibit cardio-protective and anti-inflammatory effects by regulating lipid metabolism and inflammatory signaling pathways. These findings suggest that animal-derived medicinal substances may represent valuable sources of pharmacologically active molecules with potential applications in modern therapeutics.

However, the integration of these materials into contemporary medical practice faces several challenges. One major limitation is the lack of rigorous clinical studies evaluating their safety and efficacy. Most available evidence is derived from in vitro experiments or pre-clinical animal models, while well-designed human clinical trials remain relatively scarce. This gap between traditional usage and clinical validation is a common issue in ethno-pharmacological research and highlights the need for systematic pharmacological and clinical investigations.

Another important concern relates to biodiversity conservation. Some animal species traditionally used in medicinal preparations are threatened due to over-exploitation, illegal trade, and habitat degradation. The use of certain animal products such as musk, coral, and other wildlife-derived materials raises ethical and environmental concerns that must be addressed through appropriate regulatory frameworks. Sustainable harvesting practices, synthetic substitutes, and alternative biotechnological approaches should therefore be considered to ensure the conservation of biological

resources while maintaining the therapeutic potential of traditional medicines.

Advances in modern scientific technologies have opened new avenues for investigating natural products derived from animal sources. Techniques such as metabolomics, proteomics, and molecular pharmacology allow detailed characterization of complex biological compounds and their mechanisms of action. These interdisciplinary approaches may facilitate the identification of novel bioactive molecules and provide insights into their pharmacological targets. Such research may ultimately contribute to the development of innovative therapeutic agents while preserving valuable traditional knowledge systems that have evolved over centuries.

6. Evidence Level Analysis:

The analysis of available literature indicates that the scientific evidence supporting the therapeutic use of animal-derived medicinal substances remains heterogeneous. Based on the reviewed studies, the level of evidence can be broadly categorized into four groups: traditional evidence, in vitro studies, animal studies, and clinical evidence.

The majority of available studies fall within the in vitro and experimental animal research categories, which together account for a substantial proportion of the pharmacological evidence. In vitro investigations have demonstrated antimicrobial, anti-inflammatory, and antioxidant properties of several animal-derived compounds, including peptides, fatty acids, and enzymes. Experimental animal studies further support these findings by illustrating potential therapeutic effects in disease models as shown in Figure 2.

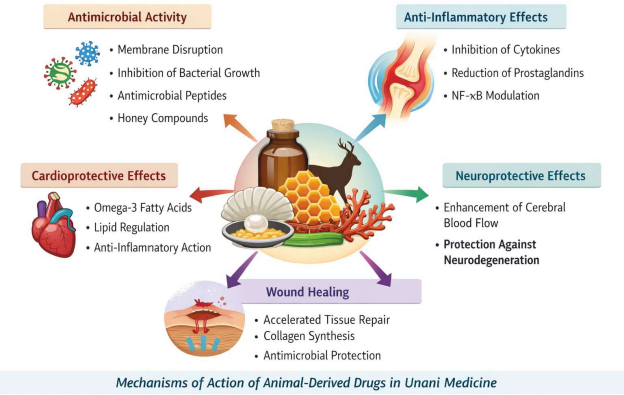

Figure 2

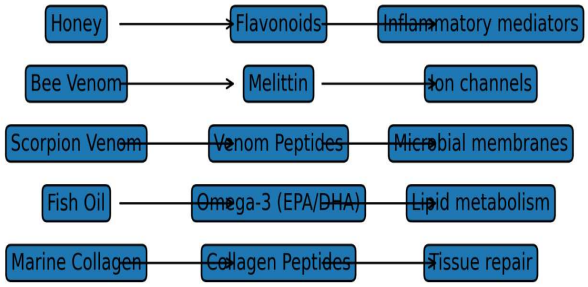

Figure 3. Drug–compound–target interaction network illustrating the relationship between representative animal-derived drugs used in the Unani system, their major bioactive compounds, and the molecular targets responsible for pharmacological effects

However, clinical evidence remains relatively limited, indicating that only a small proportion of animal-derived medicinal substances have undergone rigorous human clinical evaluation. This gap highlights the need for well-designed clinical trials to confirm the safety, efficacy, and therapeutic applicability of these substances in modern medical practice.

Traditional ethno-medical knowledge continues to provide an important foundation for identifying potential therapeutic agents. Nevertheless, translating such knowledge into evidence-based medicine requires systematic pharmacological investigations and clinical validation.

Table (2). Major Pharmacological Targets of Animal-Derived Compounds

Compound Type	**Example Source**	**Molecular Targ**
Venom peptides	Scorpion	Ion channels
Antimicrobial peptides	Bee venom	Bacterial membr
Omega-3 fatty acids	Fish oil	Lipid metabolisn
Collagen peptides	Marine organisms	Tissue repair pat
Mineral complexes	Coral, pearl	Calcium signalin

The distribution of evidence levels observed in the present review is summarized below.

Evidence Level	Percentage
Clinical evidence	10%
Animal studies	35%
In vitro studies	40%

Evidence Level	Percentage
Traditional evidence	15%

Overall, the evidence profile indicates that although experimental research supports several traditional claims, clinical validation remains insufficient. Future studies should therefore focus on advanced pharmacological investigations and controlled clinical trials to establish the therapeutic potential and safety of animal-derived medicinal substances used in the Unani system of medicine.

7. Limitations:

The present review has several limitations that should be considered when interpreting the findings. First, the availability of clinical evidence for many animal-derived medicinal substances remains limited, as most available studies are based on in vitro experiments or pre-clinical animal models rather than well-designed clinical trials. Consequently, the therapeutic efficacy and safety profiles of many of these substances require further clinical validation.

Second, variations in traditional preparation methods, dosage forms, and regional practices may influence the pharmacological outcomes associated with animal-derived medicinal products. Such variations can lead to inconsistencies in reported therapeutic effects and complicate efforts to standardize these materials for modern medical use.

Finally, differences in biological sources, environmental conditions, and processing techniques may affect the chemical composition and bioactivity of animal-derived substances. Future research should therefore focus on standardized experimental protocols, advanced analytical characterization, and well-designed clinical investigations to better evaluate the safety, efficacy, and therapeutic potential of these traditional medicinal resources.

8. Conservation and Sustainability:

The use of animal-derived medicinal substances in traditional medical systems raises important concerns regarding biodiversity conservation and sustainable resource utilization. Several animal species historically used in traditional medicine are vulnerable to over-exploitation due to increasing medicinal demand, illegal wildlife trade, and habitat degradation. For example, animal products such as musk, coral, and certain marine-derived materials have been associated with ecological pressure on wildlife populations. These concerns highlight the need for responsible and sustainable approaches to the use of animal-derived medicinal resources.

Table (3). Conservation Status of Selected Animal-Derived Medicinal Sources

Animal Source	Example Drug	Conservation Concern	Proposed Alternatives
Musk deer	Musk	Endangered species	Synthetic muscone
Coral species	Coral calcium	Reef ecosystem damage	Mineral substitutes
Whale species	Ambergris	Marine protection laws	Synthetic fragrance compounds
Bees	Honey, venom	Pollinator decline	Sustainable apiculture
Marine fish	Fish oil	Overfishing	Algal omega-3 oils

Unsustainable harvesting practices may lead to population decline of certain species and disruption of ecological balance. Consequently, conservation strategies should be integrated into ethno-pharmacological research and traditional medicine practices. Regulatory frameworks, wildlife protection laws, and international agreements aimed at conserving endangered species play an important role in controlling the trade and use of animal-derived materials in medicinal formulations.

In recent years, several alternative approaches have been proposed to address these challenges. The development of synthetic analogues, biotechnological production of bioactive compounds, and plant-based substitutes may help reduce dependence on endangered animal species while maintaining therapeutic efficacy. In addition, sustainable aquaculture and controlled harvesting practices may provide viable solutions for obtaining certain marine-derived medicinal substances without compromising ecological stability.

Table (4). Comparison of Animal-Derived and Plant-Derived Drugs in Traditional Medicine

Feature	Animal-Derived Drugs	Plant-Derived Drugs
Biological origin	Animals, insects, marine organisms	Herbs, shrubs, trees
Examples	Musk, honey, coral, pearl, scorpion venom	Turmeric, neem, ginseng
Major bioactive compounds	Peptides, enzymes, fatty acids, sterols	Alkaloids, flavonoids, terpenoids

Feature	Animal-Derived Drugs	Plant-Derived Drugs
Traditional role	Cardio-tonics, aphrodisiacs, wound healing	Anti-inflammatory, antimicrobial
Scientific validation	Limited clinical evidence	Extensive pharmacological studies
Sustainability concerns	Wildlife conservation issues	Agricultural sustainability

Therefore, integrating conservation biology with ethno-pharmacological research is essential to ensure that the traditional use of animal-derived medicinal substances does not threaten biodiversity. Sustainable utilization strategies will help preserve valuable biological resources while allowing continued exploration of their pharmacological potential.

9. Drug Discovery Potential:

Animal-derived natural products represent a valuable reservoir of bioactive compounds with significant potential for modern drug discovery. Traditional medical systems, including the Unani system of medicine, have historically utilized numerous animal-derived substances for therapeutic purposes. These materials often contain biologically active molecules such as peptides, enzymes, lipids, and mineral complexes that exhibit diverse pharmacological activities. Modern pharmacological research has increasingly recognized these natural compounds as promising leads for the development of novel therapeutic agents.

Animal venoms and secretions are particularly rich sources of pharmacologically active peptides with high specificity toward molecular targets such as ion channels, receptors, and enzymes. Several venom-derived compounds have demonstrated significant antimicrobial, analgesic, and anticancer properties in experimental studies. These findings highlight the importance of animal-derived toxins as templates for drug design and development.

In addition, marine organisms represent an important source of structurally unique natural products with diverse biological activities. Marine-derived compounds have been investigated for their potential applications in the treatment of infectious diseases, cardiovascular disorders, and neurological conditions. For example, omega-3 fatty acids derived from marine fish have demonstrated cardio-protective effects through modulation of lipid metabolism and inflammatory pathways.

The successful development of several modern drugs from animal-derived toxins further demonstrates the translational potential of these natural products. For instance, captopril, an anti-hypertensive drug, was developed from peptides found in snake venom, while ziconotide, a potent analgesic used for severe chronic pain, was derived from cone snail venom peptides. These examples illustrate how traditional knowledge and natural product research can contribute to the discovery of innovative therapeutic agents.

Advances in modern technologies such as metabolomics, proteomics, and high-throughput screening have significantly enhanced the ability to identify and characterize bioactive compounds from natural sources. Integrating ethno-pharmacological knowledge with these modern scientific approaches may accelerate the discovery of novel drug candidates derived from animal-based medicinal resources.

Overall, the exploration of animal-derived natural products within traditional medical systems offers promising opportunities for the identification of new pharmacologically active molecules and the development of innovative therapeutic strategies.

10. Translational Research Potential:

The integration of traditional medical knowledge with modern biomedical research provides valuable opportunities for the discovery and development of novel therapeutic agents. Animal-derived medicinal substances described in the Unani system of medicine represent a promising source of bioactive compounds that may serve as potential leads for pharmaceutical development. Translational research approaches aim to bridge the gap between traditional therapeutic practices and evidence-based medicine by systematically evaluating the pharmacological properties and molecular mechanisms of these natural products.

Recent advances in analytical and molecular techniques have significantly enhanced the ability to identify and characterize bioactive compounds from natural sources. Technologies such as metabolomics, proteomics, genomics, and high-throughput screening enable comprehensive investigation of complex biological materials and facilitate the discovery of novel pharmacologically active molecules. These approaches allow researchers to identify specific molecular targets and elucidate the mechanisms underlying the therapeutic effects of animal-derived substances.

In addition, experimental pharmacology and pre-clinical studies play a critical role in validating the traditional uses of these materials. Controlled laboratory investigations using cellular and animal models can provide important insights into the safety, efficacy, and pharmacokinetic properties of bioactive compounds. Such studies are essential for establishing

the scientific basis of traditional medicinal practices and identifying promising candidates for further drug development.

Furthermore, the successful translation of traditional remedies into modern therapeutics requires well-designed clinical trials to evaluate their safety and therapeutic efficacy in human populations. Clinical validation is an essential step in transforming ethno-pharmacological knowledge into evidence-based medical interventions. Collaboration among pharmacologists, clinicians, ethno-botanists, and conservation scientists will therefore be crucial for advancing translational research in this field.

Overall, the integration of ethno-pharmacology with modern biomedical research has the potential to transform traditional zoo-therapeutic knowledge into innovative therapeutic strategies. By combining traditional medical insights with contemporary scientific methodologies, animal-derived natural products may contribute to the development of new drugs while simultaneously promoting the sustainable utilization of biological resources.

11. Key Insights:

The present review provides a comprehensive overview of animal-derived medicinal substances used in the Unani system of medicine and highlights their pharmacological relevance in contemporary biomedical research. Forty-Eight (48) animal-derived drugs documented in classical Unani literature were systematically analyzed with respect to their biological sources, traditional therapeutic uses, bioactive compounds, and available scientific evidence.

One of the major insights emerging from this review is the remarkable diversity of animal-derived medicinal materials used in traditional pharmacotherapy. These substances originate from a wide range of biological sources, including insects, marine organisms, mammals, reptiles, birds, and aquatic species, reflecting the deep ecological knowledge embedded in traditional medical systems.

Another key finding is the presence of pharmacologically active molecules such as peptides, enzymes, fatty acids, sterols, and mineral complexes within many animal-derived substances. Experimental studies have demonstrated that these compounds exhibit a variety of biological activities, including antimicrobial, anti-inflammatory, cardio-protective, neuro-protective, and wound-healing effects. These observations support the therapeutic potential of animal-derived natural products as valuable sources of drug leads.

However, the review also reveals significant research gaps, particularly in relation to clinical validation and safety evaluation. While many traditional claims are supported by experimental studies, rigorous clinical investigations remain limited. Furthermore, issues related to biodiversity conservation and ethical sourcing highlight the importance of developing sustainable approaches to the utilization of animal-derived medicinal resources.

Overall, the findings emphasize the need for interdisciplinary research integrating ethno-pharmacology, pharmacology, and conservation science in order to transform traditional zoo-therapeutic knowledge into evidence-based therapeutic strategies.

12. Future Perspectives:

Future research on animal-derived medicinal substances used in the Unani system of medicine should focus on several key areas to advance their scientific validation and therapeutic application. First, comprehensive chemical and biochemical investigations are required to identify and characterize the bioactive compounds responsible for the pharmacological activities of these substances. Advances in analytical techniques such as metabolomics, proteomics, and high-resolution mass spectrometry provide powerful tools for exploring the complex composition of animal-derived natural products.

Second, detailed mechanistic pharmacological studies are necessary to elucidate the molecular targets and signaling pathways involved in the therapeutic effects of these compounds. Understanding these mechanisms may facilitate the identification of novel drug targets and contribute to the development of innovative therapeutic agents for the treatment of inflammatory, infectious, metabolic, and neurological disorders.

Third, well-designed clinical trials are essential to evaluate the safety, efficacy, and dosage standardization of promising animal-derived medicinal substances. Clinical validation represents a critical step in translating traditional ethno-pharmacological knowledge into evidence-based medical practice.

Another important research direction involves the development of sustainable and ethical alternatives for animal-derived medicinal products. Strategies such as synthetic production of bioactive compounds, biotechnological approaches, and plant-based substitutes may help reduce pressure on vulnerable animal species while preserving therapeutic benefits.

Finally, interdisciplinary collaboration among ethno-pharmacologists, pharmacologists, clinicians, and conservation scientists will be essential for integrating traditional medical knowledge with

modern biomedical research. Such collaborative efforts may enable the responsible utilization of animal-derived medicinal resources while promoting the discovery of novel therapeutics and preserving valuable traditional medical heritage.

13. Conclusion:

Animal-derived medicinal substances constitute an important yet relatively under-explored component of the Unani system of medicine. The present review highlights the remarkable diversity of animal-derived drugs described in classical Unani literature and their potential pharmacological relevance. These substances contain a variety of bioactive molecules, including peptides, enzymes, fatty acids, and mineral complexes, which have demonstrated antimicrobial, anti-inflammatory, cardio-protective, neuro-protective, and wound-healing activities in experimental studies.

Despite their long history of traditional use and promising pharmacological evidence, the translation of these substances into modern clinical practice remains limited. Challenges related to insufficient clinical validation, lack of standardized formulations and concerns regarding biodiversity conservation and ethical sourcing must be addressed before their widespread therapeutic application can be realized. Future interdisciplinary research integrating ethno-pharmacology, pharmacology, natural product chemistry, and conservation science is essential to unlock the full therapeutic potential of animal-derived medicinal resources. Such efforts may facilitate the development of novel evidence-based therapeutic agents while simultaneously promoting the sustainable utilization of biological resources and the preservation of valuable traditional medical knowledge.

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Acknowledgement

I am deeply grateful to the Director General, Central Council for Research in Unani Medicine (CCRUM), and to our supervisor and mentor, Prof. Hakeem Abdul Mannan, late Prof. Misbah Uddin Siddiqui of Aligarh Muslim University, Aligarh and late Prof. Basheer Ahmed, Ex-Principal, Government Nizamia Tibbi College, Hyderabad for their continuous encouragement, invaluable guidance, and unwavering support throughout our academic and professional journey.

Declarations:

Ethics approval and consent to participate

Not applicable. This is a review article involving no primary data collection from human or animal subjects.

Consent for publication

Not applicable.

Availability of data and material

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions:

M. A. Waheed : Conceptualization, Methodology, Writing - original draft, Supervision.
Md. Manzar Alam : Formal analysis, Visualization, review & editing.
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Mohd. Najeeb Khan : Writing - review & editing.
Syed Touheed Ahmad : Resources, Validation, Writing - review & editing.
Jamal Akhtar : Data curation.
N Zaheer Ahmed : Project administration.

All authors read and approved the final manuscript.

Use of Generative AI Statement:

The authors utilized generative AI tools (Chat GPT by OpenAI, Gemini by Google, and Paperpal) to assist in language enhancement, grammatical correction, and polishing of the manuscript. All scientific content, data analysis, and conclusions were conceived and verified by the authors.

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