

Formulated Therapeutic Products of Animal Fats and Oils: Future Prospects of Zootherapy

Bharat Mishra*, MV Akhila, Ann Thomas, Biliya Benny, Hiba Assainar
Nirmala College of Pharmacy, Muvattupuzha, Ernakulam, Kerala, INDIA.

ABSTRACT

In the traditional system of practices, animal fats and its oil gained acceptance in healing various ailments. Fats are chemically triglycerides in which glycerol is esterified with three fatty acids. The fats are generally obtained from animal by rendering methods. The main difference between fat and oil is that they are solid and liquid at room temperature respectively. Fatty acid composition present in oil is determined by GC-MS analysis. And it mainly includes oleic acid, palmitic acid, stearic acid, linoleic acid and linolenic acid. This composition plays an important role in antimicrobial, anti-inflammatory, antibacterial activities. The therapeutic products from the animal's fat and oils are presenting the tremendous acceptability for human, while used by various route of administrations for various internal and external therapeutic indications. This merit of the animal's fat and oils make it an exceptional choice for using them as a drug. The key fatty acid present in the oil are mainly responsible for the therapeutic activity. The different types of fat obtained from varieties of animal include crocodile, turtle, lizard, sheep, cobra, shark, python etc. Lack of scientific evidence for

the traditional healing practice using animal fats or its oils make researchers to scientifically prove the therapeutic activity and this may lead to the new era for the development of a variety of novel formulations. Animal based products are also gained importance along with animal based medicines. This article focuses on various animal fats, its traditional uses and some of the formulations developed recently by using these.

Key words: Zootherapy, Animal Fat, Animal Oil, Animal Product, Formulated Animal Products.

Correspondence

Dr. Bharat Mishra, M.Pharm., FICS

Professor and Head, Department of Pharmacology and Research and Development Cell Nirmala College of Pharmacy, Muvattupuzha-686661, Ernakulam, Kerala, INDIA.

Phone no: +91-7275902555

Email: bharatekansh@gmail.com

DOI: 10.5530/ijpi.2020.2.20

INTRODUCTION

Fats are mainly produced from plant, marine and animal sources. Fats obtained from animals can be used both for food and medical applications and these fats are produced mainly through rendering method which has been developed and practiced over since last 200 years. There are literatures having the details of use of animals and animal products for healing purposes from pre-historic times.¹ In this process slaughtered animals by products are converted into useful marketable products including food, agricultural, medicine and industrial use. Animal fat stands as a natural versatile basis for many products and more than 25 million tons of animal fats are produced worldwide.² Different categories of animal fats are available; include, tallow, lard, fish oil and butter. All of these can be utilized in various therapeutic and non-therapeutic applications. 40% of Bovine animals are utilized for meat and meat products and in case of porcine animals 62% are utilized.³ Fats are also obtained from small birds like chickens and turkeys to big birds like ostrich. Lard obtained by rendering adipose tissues of pig is rich in mono unsaturated fatty acids (MUFA), that is, oleic acid and also some amount of polyunsaturated fatty acid (PUFA) linoleic acid. Animal fats are chemically triglycerides in which glycerol is esterified with three fatty acids and made up of long chain fatty acid or saturated fatty acids. These saturated fatty acids have high melting point and are thermally stable. Animal fats are either solid or liquid at room temperature. If the product obtained is liquid, it is classified as oil. Examples are emu oil and lard oil.⁴ Lipids can be divided into four categories: simple, compound, derived and terpenoids. Simple lipids are defined as esters of fatty acids with alcohols, particularly glycerol and cholesterol. These can be divided into three classes: triglycerides, steroids and waxes.⁵ Triglycerides, in which

glycerol is esterified with three fatty acid. Steroids are lipids that cannot be saponified, which means that they cannot be hydrolyzed by heating in the presence of alkalis and soap is not produced from their fatty acids. The most abundant steroids are sterols among which cholesterol is the main sterol of animal tissues. Waxes are defined as esters of fatty acids with long chain alcohols and constitute the natural protecting coverage of leaves, stems, insects, skin, feathers and hairs and also, they act as the structural material of beehives. They possess no nutritional value because they are hydrophobic in nature and cannot be degraded by the digestive enzymes of superior animals.⁶ They are further divided into phospholipids, glycolipids and lipoproteins.⁷ The article offers limited information about an animal product which has a reputation in therapeutics from ancient era i.e., the fat and oil and the possible formulations attempted by the researchers and presented to the scientific world for further studies.⁸ These products are establishing a respectful and trustworthy platform for the zootherapy in the era of modern therapeutics. Zootherapy refers to the use of the animal products in the healing processes against various human diseases.⁹

METHODOLOGY

A literature review of the published literature regarding several animal fats, oils, other products and including the therapeutic importance of animal medicines was performed. A descriptive analysis regarding these animal fats or oils was made.

A search was conducted using the popular Internet based scientific data bases such as Scencedirect, PubMed, Springer, Elsevier etc. as well as in other sources such as research paper based journals and scientific books

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

that were available. The keywords used were animal based products, animal fats, animal oils, zootherapy etc.

A particular consistency was followed: Defining the study question: What are the various animal fats and oils used therapeutically and the future prospects of zootherapy? The key words “animal based medicines” AND “animal fats” OR “animal oils” AND “zootherapy” etc. were given as input in the data bases PubMed, NCBI, Springer etc. Clinical Queries. Other relevant sources of information were also reviewed thoroughly and the suitable papers were selected and finally compiled together to form the review article.

ANIMAL BASED MEDICINES

The modern system of practice finds importance in the use of animal fats and oil which leads to the development in the field of medicine. Several therapeutic products can be developed from these fats. Traditionally animals have been used as medicinal resources for various ailments throughout the world. Various folk medicines were derived from animal body parts, from products of its metabolism or from non- animal material.¹⁰ The healing of human ailments by using therapeutics that are obtained from animals or ultimately are derived from them is known as zootherapy and this is performed by a trained and qualified zootherapist.⁸

Animal products that is being used traditionally includes the blood of the black caiman (*Melanosuchus niger*) is used to treat epilepsy and stroke. Ants of the genus *Pseudomyrmex* are used in toothache or are left to bite painful joints. Fats of the lion (*Panthera leo*) and hyena (*Crocuta crocuta*) are used topically to alleviate abdominal pains.⁶ Tusks of hippo are used as aphrodisiacs and ornamentals; the fat extracted from manatee (*Trichechus senegalensis*) used to cure rheumatism, boils and backache.¹¹ According to traditional Chinese medicine, earthworm possess antipyretic, antispasmodic, diuretic, antihypertensive, antiallergic, anti- asthmatic, detoxicant and spermatocidal effect as well as alleviation of Rheumatism.⁸ In traditional Chinese medicines, great varieties of animal fats are being used for divergent therapeutic purposes, some of which are even related to tissue regeneration.¹² One of the important principles for the ancient healers in China is that they believe food and therapeutic agents coexist. Fats could be obtained both from domestic and wild animals. Domestic animals used include cow and bull, sheep, pig, donkey and the main wild animals used are deer, shark, snake, bear, frog etc.¹³

THERAPEUTICALLY USED ANIMAL FATS AND OILS

Ostrich Oil

Ostrich (*Struthio camelus*) is a species of large flightless bird native to hot countries like Thailand and Australia. It belongs to the family Struthionidae. Oil is obtained from its adipose tissue which is rich in triglycerides and essential fatty acids like alpha-linolenic acid and linoleic acid. Due to the presence of these essential fatty acids the oil is well known for its nutritional, cosmetic and pharmaceutical uses. It has a very good free radical scavenging activity and the capability of oil in defending membranes from oxidative stress is related to its fatty acid composition, Vitamins and amino acids.¹⁴ The presence of antioxidants makes it a healthy food and various other compounds such as carotenoids, tocopherol and flavones show therapeutic benefits. Oil is also having an anti- inflammatory, antibacterial activity and is considered as a good skin protectant.¹⁵

Oil can be prepared by rendering which is regarded as the most conventional method and this can be done in two ways classical method

and developed processing method. In classical processing method, oil obtained by rendering the adipose tissue at high temperature without adherent tissue cleaning and drying step while in developed processing method, tissue was cleaned and dried and rendered at low temperature. The dominant fatty acids present in both the oils obtained include lauric acid, oleic acid, palmitic acid, followed by stearic acid, myristic acid and lauric acid.¹⁶

Emu oil

The anti-inflammatory and antioxidant activity was shown by emu oil which is obtained from emu (*Dromaius novaehollandiae*) native to Australia. This activity was mainly due to the polyunsaturated fatty acids. The liquid fat of emu can be used topically for various ailments such as wound healing, to alleviate pain and for musculoskeletal disorder. Apart from the medicinal use, it also has nutritional and health benefits.¹⁷ They also have moisturizing and cosmetic properties. Emu meat is low in cholesterol and the different 3 and 6 fatty acids present are α -linolenic acid, linoleic acid, arachidonic and docosahexaenoic acid which serve as a good source of nutrition. The chicken and beef meat contain less amount of polyunsaturated fatty acid than emu meat.¹⁸

The various activities of emu oil include, it has been used as an alternative therapy for chemotherapy induced mucositis, inflammatory bowel disease such as ulcerative colitis and Crohn's disease can be treated by emu oil through its ability to enhance repair process.¹⁹ Auricular inflammation has been decreased by emu oil, osteoporosis caused by cancer chemotherapy can be reduced by non-glyceride components of emu oil. The total cholesterol (TC) and low density lipoprotein (LDL) are reduced by emu oil and showed hypocholesterolemia activity. It stimulates skin and hair growth by topical or parenteral administration. Non irritating nature of emu oil provides moisturizing and cosmetic properties along with good penetrating ability. Emu oil can be used as a transdermal vehicle or penetration enhancer. Topically applied emu oil act as an excellent insect repellent. Emu oil was also effective in psoriasis.²⁰

Crocodile oil

The antimicrobial and anti-inflammatory properties of crocodile obtained from the Nile crocodile (*Crocodylus niloticus*) was used by traditional practitioners to treat microbial infections and inflammatory conditions. Gas chromatography was performed for determining the fatty acid composition. The major components of oil include oleic acid, palmitic acid and linoleic acid along with sixteen other fatty acids. Activity of the oil against *Staphylococcus aureus*, *klebsiella pneumonia* and *candida albicans* was done by micro plate method. The anti-inflammatory activity of the oil was assessed by oral administration and topical application using a mouse of acute croton oil induced contact dermatitis. The anti-inflammatory assays showed optimal activity at three hours after the administration of oil (60.8%) and at twelve hours after topical application (57.5%). The anti-inflammatory assay showed longer duration of action after topical application when compared with oral administration of oil.²¹

Paleosuchus palpebrosus also known as Cuvier's smooth fronted Caiman, Dwarf Caiman is the smallest crocodylian species mainly found in the neotropical region and also in the Amazon and Orinoco River. Atlantic coast waste drainage area.²² The presence of a crest crown on the posterior region of the head is the striking feature of this species. The products obtained from the species is used in the treatment of diseases or conditions like asthma, thrombosis, rheumatism, edema, mycosis, sore throat and as an antidote for snake bite.²³

Cobra oil

Oil is obtained from the depot fat of *Naja kaouthia*, a cobra oil. Snake oils have been used as traditional remedies in skin care and many diseases and cobra oil was traditionally used in Thailand. It is also used to prevent excessive hair loss, migraine and in treating fractured bone.²⁴ The obtained depot fat was cut and blended and then it was incubated at 37°C. The oil was extracted through simple methods and fatty acid composition was determined using GC-MS. Unsaturated fatty acids were found to be higher than that of saturated fatty acids that is, 55.16% and 26.29% respectively.²⁵ The dominant fatty acid present in cobra oil was palmitic acid, followed by vaccenic acid and linoleic acid.¹³ Antioxidant activity of cobra oil was detected by DPPH free radical scavenging and found out that the oil could inhibit free radical scavenging. Investigations on cytotoxicity effect of oil on cancer line cells was done by MTT assay for which three cancer cells KATO-3, HepG2 and SW620 were treated with various concentrations for 24, 48 and 72 hr of incubation and declining of cell counts was noticed and showed that some of the fatty acids components in cobra oil was responsible for its activity.²⁴

Turtle oil

Phrynops geoffroanus is South American Turtle mainly found in lakes, rivers and stream with a carnivorous diet. The oil obtained from the body fat of this animal is used traditionally to treat illness such as sore throat, mumps, rheumatism, arthritis and is the oil is also having antimicrobial activity.²⁶ The specimen is collected and anesthetized using ketamine, sacrificed and their body fat was removed and the oil was extracted with hexane using Soxhlet apparatus. The determination of fatty acid was done by GC-MS and the main components were found to be palmitoleic and oleic acid (58.39% and 15.7% respectively).²⁷ Anti-inflammatory action was tested in certain strains of bacteria and the anti-microbial activity was proved. The antimicrobial activity is due to the presence of above unsaturated fatty acid.²⁶ *Phrynops tuberosus*, commonly called as Peter's side necked turtle generally found in Guyana, the south eastern portion of Venezuela, Suriname, French Guyana, the eastern Amazon basin and in areas of northeastern Brazil. The species is widely used as food and is a popular medicine for treating asthma, sore throat, swelling, earache, rheumatism and arthritis.²⁷ Indian turtle, *Erthmochelies imbricata* is mainly found in the Bay of Bengal least coast of Madras state. The fat obtained from its body was refined and freed of phosphatides. Then it was hydrolyzed and the preliminary separation of the mixed fatty acids into groups differing in unsaturation was done by Lead salt-ethanol and Lithium salt-acetone methods. Ester fractionation procedure was used for finding compositions of resulting fractions. The major fatty acids present in it was found to be myristic acid (10%) and 15% of palmitic acid.²⁸

Sheep fat

It is obtained from tails of domestic sheep, *Ovis aries* by directly removing the fat content and oil can be prepared using rendering methods. The main fatty acids present in sheep oil includes palmitic acid (28–29%), stearic acid (13–15%), myristic acid (3–4%) and other unsaturated fatty acids. On comparison with cow fat sheep fat appears harder and contains more saturated fatty acids.²⁹ Generally, it is used for soothing “toxicity,” debilitation, diarrhea, constipation and polydipsia. Externally sheep fat is indicated for cracking skin, burns, frostbites and skin infection. It is contraindicated for those suffering from common cold with cough and sputum. The sheep fat is effectively used in treating damage induced knee articular joint with formalin.³⁰

Shark fat

The shark oil is taken from the livers of the sharks, which are heated to give the oil. Shark fat contains a rich supply of squalene, alkylglycerols, Vitamins A and D as well as polyunsaturated fatty acids in low amounts. It is believed that shark oil might have anti-cancer effects since these constituents are modulators of immunity and alkylglycerols and squalene are responsible for anti-tumor activity via different mechanisms like induction of apoptosis of neoplastic cells, suppression of signal transduction, inhibition of angiogenesis and promoting transmembrane transport of cytotoxic agents. In the past decades, this marine item has been used as an oral agent for the treatment of different types of cancer. Cancers arising from the upper gastrointestinal tract, namely, esophagus and stomach are believed to be able to get the best benefits. They have also been recommended in patients suffering from atopic dermatitis.³¹

Python fat

Python fat can be extracted from various wild python species like *Python sebae*, *Python molurus*, *Python tigris* etc. and it is seen to have a golden yellow color which turns to pale yellow on standing.²⁸ It has proven its effectiveness in the treatment of rheumatism, boils, keloids and broken bones etc.²⁵ In the case of keloids, which exhibit excessive collagen deposition, python fat has shown to decrease the collagen accumulation possibly with increased collagenase activity. This was demonstrated through *in-vitro* studies on keloid tissues from patients which were surgically removed and treated with python fat, revealed a successive decrease in the collagen concentration and dose dependent increase in collagenase activity with increasing amount of python fat.²⁸

Python regius, smallest non-venomous python species found in Africa. The fat obtained from them, had a hypoglycemic potential and the effect was studied by treating alloxan induced diabetic rats with different concentrations of fat for 14 days. There was a decrease in blood glucose levels in the experimental rats after its oral administration concluding its hypo-glycemic effect.¹¹

Lizard fat

Indian Spiny-tailed lizard *Saara hardwickii* is a unique herbivorous reptile that belongs to the family Uromastycidae.³² The species is found in patches across the arid zones in India, Afghanistan and Pakistan. In India, it is distributed mostly throughout Thar Desert of Rajasthan and Gujarat and it is the only herbivorous lizard in India.³³ Lizards can be identified through natural marks in their body which includes stripes blotches in young, body notches, broken tails and sloughed skin.³⁴ Oil is mainly obtained from its skin and tail. It is mainly used as an aphrodisiac and also has other medicinal uses.³²

Peter's lava lizard (*Tropidurus hispidus*) is a small sized animal belonging to the family Tropiduridae. This species is mainly found in northeastern Caatinga and in the open areas in the northern portion of the Amazon River. It is widely used as a popular medicine to treat alcoholism, dermatomycosis, warts, boils, sore throat and to treat umbilical cord of newborn babies.³⁵

FORMULATED ANIMAL OILS AND FATS

Crocodile oil burn ointment

A novel ointment formulation crocodile oil burn ointment (COBO) was developed to provide more efficient burn wound healing activity. It also has significant antinociceptive and anti-inflammatory activity. Crocodile oil was extracted from the fatty tissue of crocodile (*Crocodylus siamensis*) and it was traditionally used for the treatment of various ailments such

as skin rashes and to promote wound healing. Mainly the practice of healing was observed in traditional Chinese and south east medicine. The fatty acid present in oil was palmitic acid, oleic acid and linoleic acid. The experiment was carried by developing an ointment and burn wound was carried out in Wistar albino rats by inducing a deep secondary burn wound. It was then observed for burn wound, healing and anti-inflammatory activity. The results showed that the COBO would enhance the burn wound healing as well as accelerates skin regeneration and growth of hair follicles. It also has an analgesic and anti-inflammatory activity.³⁶

Lipid emulsion containing fish oil

Intravenous lipid emulsion (ILE) containing fish oil has been approved to use in US. Its lower triglyceride concentration, inflammatory markers and liver function enzymes and improves morbidity and mortality outcomes in critically ill surgical patients. In earlier studies showed that soya bean oil was used instead of fish oil which causes mortality in surgically ill patients. So, an alternative fish oil intravenous lipid emulsion (FOILE) was developed and could improve patient care for surgical patients. FOILE has found to be safer, improved the outcomes and it was an alternative standard of care.³⁷

Ostrich oil based nano emulsion

The oil was obtained from fats of *Struthio camelus* belonging to the family Struthionidae, having anti-inflammatory activity. Different fatty acids such as linoleic acid, palmitic acid, linolenic acid, oleic acid was present in the oil. Oleic acid present in it helps in penetration of the oil deeply into the tissues. Nano emulsions are colloidal particulate system, transparent clear and thermally stable emulsion of oil, surfactant and co surfactant with size of globules 100 nm. The experiment was carried out by developing a formulation of nano emulsion using ostrich oil.⁵ The prepared nano emulsion was assessed for various physiochemical parameters. *In vitro* inflammatory studies were carried out in male Wistar rats by carrageenan induced paw edema. The results showed that novel preparation accelerated the anti-inflammatory activity.¹⁴

Emu oil based Nano Emulgel

Emu oil was derived from the emu bird (*Dromaius novaehollandiae*) and it showed anti-inflammatory, analgesic, anesthetic, antioxidant activity. Most of fatty acids in emu oil are unsaturated and the major one is oleic acid. Curcumin is a yellow colored phenolic pigment along with other curcuminoids like dimethoxy curcumin, bisdemethoxy curcumin curcumin in the rhizomes of *Curcuma longa* (Zingiberaceae). Curcumin shows a spectrum of activities like anti-inflammatory, antihyperlipidemic, anticancer, antiviral, antimicrobial, antispasmodic activities. The experiment involves the preparation of curcumin loaded Nano emulsion by dissolving curcumin in emu oil and then incorporated into Carbopol gel for the convenient application by topical route. The emu oil based curcumin nanogels for transdermal delivery of curcumin was a suitable approach to bypass the first pass metabolism. Thus, its synergistic activity accelerated the anti-inflammatory, antioxidant and analgesic activity in joint synovium and ameliorates arthritis.³⁸

CONCLUSION

Traditionally animals have been used as a medicinal resource for the treatment of various ailments. The fats obtained from the animals were used for therapeutic purposes. The different therapeutic activity of animal oils was mainly due to the unsaturated fatty acids. Knowing about the therapeutic uses of animal fats helps in the development of different formulations. Bird's oils like oil obtained from ostrich are having anti-inflammatory activity and are used in ulcerative colitis, mucositis and

psoriasis. Crocodile oil is traditionally used to treat microbial infection and inflammatory conditions, used topically in contact dermatitis. The depot fat obtained from the cobra oil is having cytotoxic and are traditional remedies in skin care. Sheep fat is indicated for cracking skin, burns, frostbites and skin infections. Squalene present in shark oil is responsible for anti-tumor activity. The oil is also recommended in patient suffering from atopic dermatitis. Python fat oil is effectively used in the treatment of rheumatism, boils, keloids and broken bones etc. Spiny tailed lizards; a unique herbivorous reptile found mainly in the arid zones of India is used as an aphrodisiac. Peter's lava lizard is widely used as a popular medicine to treat alcoholism wart, boils, sore throat and to treat umbilical cord of new born babies. Several other animal oils are also used as medicines. Obtained from *Bubalus bubalis* (buffalo wax), *Ancer ancer* (goose), *Camellia japonica* (camel), *Sus scrofa* (hog), *Vulpes sp.* (fox), *Capra hircus* (goat), *Equus caballus* (horse wax), *Moschus moschiferus* (musk deer), *Ovis* (lamb), *Spalax leucodon ehrenbergi* (mole), worm, fish etc.

ACKNOWLEDGEMENT

We acknowledge the support of digital library facility provided by Nirmala College of Pharmacy, Muvattupuzha, Kerala.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

ABBREVIATIONS

MUFA: Mono unsaturated fatty acids; **PUFA:** Polyunsaturated fatty acid; **TC:** Total cholesterol; **LDL:** Low density lipoprotein; **GC:** Gas chromatography; **DPPH:** 2,2-Diphenyl-1-picrylhydrazyl; **COBO:** Crocodile oil burn ointment; **ILE:** Intravenous lipid emulsion; **FOILE:** Fish oil intravenous lipid emulsion.

REFERENCES

- Lev E. Traditional healing with animals (zootherapy): Medieval to present-day Levantine practice. *J Ethnopharmacol.* 2003;85(1):107-18.
- McDiarmid RW, Campbell JA, Touré T. Snake species of the world: A taxonomic and geographic reference. v. 1. 1999.
- Adeola MO. Importance of wild animals and their parts in the culture, religious festivals and traditional medicine, of Nigeria. *Environ Conserv.* 1992;19(2):125-34.
- Jeengar MK, Kumar PS, Thummuri D, Shrivastava S, Guntuku L, Sistla R, et al. Review on emu products for use as complementary and alternative medicine. *Nutrition.* 2015;1;31(1):21-7.
- Woodgate S, Der VJV. The role of fat processing and rendering in the European Union animal production industry. *BASE.* 2004.
- Belichovska D, Hajrulai-Musliu Z, Uzunov R, Belichovska K, Arapcheska M. Fatty acid composition of ostrich (*Struthio camelus*) abdominal adipose tissue. *Maced Vet Rev.* 2015;38(1):53-9.
- Ponphaiboon J, Limmatvapirat S, Chaidedgumjorn A, Limmatvapirat C. Physicochemical property, fatty acid composition and antioxidant activity of ostrich oils using different rendering methods. *LWT.* 2018;93:45-50.
- Costa-Neto EM. Animal-based medicines: Biological prospection and the sustainable use of zootherapeutic resources. *An Acad Bras Cienc.* 2005;77(1):33-43.
- Mahawar MM, Jaroli DP. Traditional knowledge on zootherapeutic uses by the Saharia tribe of Rajasthan, India. *J Ethnobiol Ethnomed.* 2007;3(1):25.
- Pieroni A, Grazzini A, Giusti ME. Animal remedies in the folk medical practices of the upper part of the Lucca and Pistoia Provinces, Central Italy. In Proceedings of the 4th European Colloquium of Ethnopharmacology: Paris. 2002;371-5.
- Okere OS, Okoli BJ, Adeyemo SO. Hypoglycaemic potential of *Python regius* fat. *Res J Eng Appl Sci.* 2013;192-8.
- Leung PC. Use of Animal Fats in Traditional Chinese Medicine. In *Regenerative Medicine* Springer, London. 2015;73-6.
- Khunsap S, Buranapraditkun S, Laoungbua P, Chanhome L. Fatty acid profile of Cobra Oil and its activities on skin melanoma cells. In 53. Kasetsart University Annual Conference, Bangkok (Thailand). 2015;3-6.
- Alshahrani SM. Preparation, Characterization and *in vivo* Anti-inflammatory

- Studies of Ostrich Oil Based Nanoemulsion. J Oleo Sci. 2019;68(3):203-8.
15. Gavanji S, Larki B, Taraghian AH. A review of application of ostrich oil in pharmacy and diseases treatment. J Nov Appl Sci. 2013;2(11):650-4.
 16. Palanisamy UD, Sivanathan M, Subramaniam T, Radhakrishnan AK, Haleagrahara N, Sundralingam U. Refining ostrich oil and its stabilization with curcumin. J Nutr Health Food Eng. 2015;2(2):00051.
 17. Ghosh P, Whitehouse M, Dawson M, Turner AG. Emu Products Western Australia Pty Ltd, assignee. Anti-inflammatory composition derived from emu oil. United States patent US 5,431,924. 1995.
 18. Snowden JM, Whitehouse MW. Anti-inflammatory activity of emu oils in rats. Inflammopharmacology. 1997;5(2):127-32.
 19. Li HL, Deng YT, Zhang ZR, Fu QR, Zheng YH, Cao XM, et al. Evaluation of effectiveness in a novel wound healing ointment-crocodile oil burn ointment. Afr J Tradit Complement Altern Med. 2017;14(1):62-72.
 20. Whitehouse MW, Turner AG, Davis CK, Roberts MS. Emu oil (s): A source of nontoxic transdermal anti-inflammatory agents in aboriginal medicine. Inflammopharmacology. 1998;6(1):1-8.
 21. Buthelezi S, Southway C, Govinden U, Bodenstien J, Du TK. An investigation of the antimicrobial and anti-inflammatory activities of crocodile oil. J Ethnopharmacol. 2012;143(1):325-30.
 22. Alves RR, Pereira FGA, Vieira KS, Souto WM, Mendonça LE, Montenegro PF, et al. A zoological catalogue of hunted reptiles in the semi-arid region of Brazil. J Ethnobiol Ethnomed. 2012;8(1):27.
 23. Milàn J, Kofoed J, Bromley RG, Lucas SG, Lockley MG, Spielmann JA. Crocodylian-chelonian carnivory: Bite traces of dwarf caiman, *Paleosuchus palpebrosus*, in red-eared slider, *Trachemys scripta*, carapaces. Crocodile Tracks and Traces. Albuquerque: New Mexico Museum of Natural History and Science Bulletin. 2010;51:195-9.
 24. Khunsap S, Vesaratchapong T, Laongbao P, Chanhom L, Buranapraditkun S, Pakmanee N, et al. Antioxidant, Anticancer Cell Lines and Physicochemical Evaluation of Cobra Oil. Int J Pure App Biosci. 2016;4(3):21-7.
 25. Mukherjee S, Gomes A, Dasgupta SC. Zoo Therapeutic uses of Snake Body Parts in Folk: Traditional Medicine. Journal of Zoological Research. 2017;1(1):1-9.
 26. Dias DD, Cabral ME, Sales DL, Paiva OO, Teles DA, Sousa JG, et al. Chemical composition and validation of the ethnopharmacological reported antimicrobial activity of the body fat of *Phrynosoma geoffroanus* used in traditional medicine. Evid.-Based Complementary Altern. Med. 2013;7:1540.
 27. Souza FL. Geographical distribution patterns of South American side-necked turtles (Chelidae), with emphasis on Brazilian species. Rev Esp Herpetol. 2005;19(1):33-46.
 28. Pathak SP, Dey LM. The fatty acid composition of Indian turtle fat. Biochem J. 1956;62(3):448.
 29. Cimen FK, Kockara N, Turkoglu M, Dundar C, Cetin N, Suleyman B, et al. Effect of sheep tail fat on the knee joint cartilage injury induced in rats with formalin. Int J Clin Exp Med. 2017;10(5):7573-81.
 30. Ünsal M, Gökalp HY, Nas S. Basic chemical characteristics of fresh, non-packed and vacuum-packed sheep-tail and tail-fat stored frozen for different periods. Meat Sci. 1995;39(2):195-204.
 31. Srivastava DP, Chauhan AS, Ahlawat R. Indian Spiny-tailed Lizard: First record of *Saara hardwickii* (Gray, 1827) in south-western Hisar District of Haryana, India. Zoo's Print. 2018;33(10):9-14.
 32. Das SK, Joshi M, Sahoo S. On the population status of Indian spiny-tailed lizard, *Saara hardwickii* outside the Thar Desert of Rajasthan, with a preliminary report on the herpetofauna of Sariska National Park. Herpetol Notes. 2015;8:51-4.
 33. Dutta S, Jhala Y. Ecological aspects of Indian spiny-tailed lizard *Uromastix hardwickii* in Kutch. J Bombay Nat Hist Soc. 2007;104(3):255-65.
 34. Rodrigues MT. Sistemática, ecologia e zoogeografia dos *Tropidurus* do grupo *torquatus* ao sul do Rio Amazonas (Sauria, Iguanidae). Arquivos De Zoologia. 1987;31(3):105-230.
 35. Li HL, Deng YT, Zhang ZR, Fu QR, Zheng YH, Cao XM, et al. Evaluation of effectiveness in a novel wound healing ointment-crocodile oil burn ointment. Afr J Tradit Complement Altern Med. 2017;14(1):62-72.
 36. Edmunds CE, Brody RA, Parrott JS, Stankorb SM, Heyland DK. The effects of different IV fat emulsions on clinical outcomes in critically ill patients. Crit Care Med. 2014;42(5):1168-77.
 37. Xia F, Fan W, Jiang S, Ma Y, Lu Y, Qi J, et al. Size-dependent translocation of nanoemulsions via oral delivery. ACS Appl Mater Interfaces. 2017;9(26):21660-72.
 38. Hajimoradi M, Hassan ZM, Pourfathollah AA, Daneshmandi S, Pakravan N. The effect of shark liver oil on the tumor infiltrating lymphocytes and cytokine pattern in mice. J Ethnopharmacol. 2009;126(3):565-70.

Article History: Submission Date : 11-01-2020; Revised Date : 28-01-2020; Acceptance Date : 18-02-2020.

Cite this article: Mishra B, Akhila MV, Thomas A, Benny B, Assainar H. Formulated Therapeutic Products of Animal Fats and Oils: Future Prospects of Zootherapy. Int. J. Pharm. Investigation. 2020;10(2):111-6.