Available Online at http://www.journalajst.com

ASIAN JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN: 0976-3376

Asian Journal of Science and Technology
Vol. 06, Issue 08, pp. 1721-1727, August, 2015

RESEARCH ARTICLE

ZOOTHERAPY FOR MANKIND: AN UNEXPLORED SEGMENT IN MAKE IN INDIA – A REVIEW

***[1]Saurabh Saxena and [2]Shrivastava, S. K.**

[1]Amrit Group, Infinity Benchmark, 6th Floor, Block EP&GP, Sector-V, Salt Lake, Kolkata – 700091, (W.B.), India
[2]Pt. S.K. Shastri College of Agriculture Rajnandgaon, (IGAU, Raipur), 491441 Chattisgarh, India

ARTICLE INFO

Article History:
Received 30th May, 2015
Received in revised form
12th June, 2015
Accepted 11th July, 2015
Published online 31st August, 2015

Key words:
Entrepreneurship,
Human Medicine - Animal,
Make in India,
Role of Animal and its by-products,
Rural Economy.

ABSTRACT

Historically, plants have been preferred over animals in making of human medicine. Abundant transcripts are available sharing various reasons from spiritual believe to regional cultural diversities in accepting plant products and by-products as human medicines. Thus, huge untapped potential of utilization of animal and animal by-products can be explored in making human medicines. Efforts have been made to understand "Role of Animal and its contribution in Human Medicine" as well as potential economical contribution. Liberalization and modernization has shown positive inclination towards animal made medicines due to effective results and healing potential to several diseases. Interestingly, India is one of the world's potential contributors of animal products, and by-products. Future potential employment, values and opportunities for entrepreneurs, and investor has been explored. Animal seems to play a vital role as a pivot point in growing Indian economy for years to come. It is next to impossible to oversee the animal role in making Human Medicine for a healthy mankind.

Copyright © 2015 Saurabh Saxena and Shrivastava, S. K. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

The increasing world population has worsened the serious problem of health security and medicine to cure the diseases especially in developing countries. Since ancient age animals are used to treat human problems and under the new paradigm shift of animals for drug discovery. Present era animal are increasingly being recognized not only as a source of food but also as potential source of medicine (Shrivastava *et al*., 2013) there are about 1,250,000 identified species of animal. Civilization of ancient Mesopotamia contains descriptions of fish oil, bees wax and honey, mongoose blood, turtle shell, goat's skin, gazelle, deer and sheep sinew, bird excrement, and animal fat (Thompson, 1923; Hakim, 1949 and Powell, 1993). In 5th-4th Centuries BC, Hippocrates included many animal substances like cattle milk, chicken's eggs, mammal's horns, and sea sponge in his description (Riddle, 1987 and Gillispie, 1973). Traditional Chinese Medicine (TCM) has described more than 1500 animal species for medicinal uses (Anonymous, 1995). Supplement of compendium of Materia Medica written by Zhoa Xuemin"Bencao Gangmu Shiyi" (QING DYNESTY 1616-1911 AD) in 1983 recorded up to 105 medicinal insects belong to the group of Hymenoptera, Orthoptera, Lepidontera, Mantoidea, Coleoptera, Chilopoda, Scorpionida, and Oligochaeta (Chen Yongzeng, 1995).

Corresponding author: Saurabh Saxena
Amrit Group, Infinity Benchmark, 6th Floor, Block EP&GP, Sector-V, Salt Lake, Kolkata – 700091, (W.B.), India

Role of animals in medicines seems to be very vast. Interestingly, insects have proven to be very important sources of drugs for modern medicines Arthropods are unexploited and unexplored source of potential compounds for modern medicine (Pemberton, 1999) as they have proteins, terpenoids (triterpenoids and steroids, carotenoids, iridoids, tropolenes), sugars, polyols and mucilages, saponins polyphenolic glycosides, quinines, antraquinones glkycosides, cyanogenic glycosides, and alkaloids (Andary *et al*., 1996). Oldfield (1989) recorded about 4% of the extracts evaluated in the 1970's from 800 species of terrestrial arthropods (insects included) which showed some anticancer activity.

Animal and Animal By-product – Medicinal Values

Marine animals are important sources chemicals for drug discovery; First antibacterial protein to be isolated and partially characterized from marine decapods was a 6.5-kDa proline-rich peptide with sequence similar to bactenecin 7 from mammals (Schnapp *et al*., 1996). Neosurugatoxin isolated from *Babylonia japonica* is useful in characterizing two classes of acetylcholine receptors (Ireland *et al*., 1993). Dolastatin, a cytotoxic peptide from *Dolabella auricularia* is an antineoplastic substance (Pettit *et al*., 1989). Ulapualide-A, a sponge-derived macrolide isolated from the nudibranch *Hexabranchus sanguineus* exhibits cytotoxic activity against L 1210 murine leukemia cells and antifungal activity, which exceeds that of clinically useful amphotericin-B (Rorsener and

Scheuer, 1986). Chromodorolide-A isolated from *Chromocloris cavae* exhibits *in vitro* antimicrobial and cytotoxic activities (Morris *et al*., 1990). Onchidal from *Onchidella* spp. is a useful probe for identifying the active site residues that contribute to binding and hydrolysis of acetyl cholinesterase (Ireland *et al*., 1993). Medicinal value of earthworms was recorded as far back as 1340 A.D. and is used to cure a range of diseases such as pyorrhea, postpartum weakness, small pox, jaundice and rheumatism (Reynolds and Reynolds, 1972). Compendium of Materia Medica written by Li Schizhen in 1578AD showed that animal possessed antipyretic, antispasmodic, diuretic, antihypertensine, anti-allergic, anti-asthmatic and spermatocidal properties and about 80 diseases (e.g., asthma, hypertension, mumps, ulcer, epilepsy, cancer) are cured by this creature and its extract is worth for further study especially as a new spermatocide (Zhang *et al*., 1992).

Human placenta is one of the components of a tonic. Powdered or macerated placenta is the principal ingredient of a pharmaceutical preparation called “Ha sa dai tao” in Vietnam is very effective as a general tonic and is prescribed is convalescence and in the treatment of broncho-pulmonary ailments, rheumatism, and spermatorrhoea. Collagen from the skin, hide, bone and tendons of traditional livestock industries such as cattle, pig and poultry has a wide range of uses such as anti-cancer therapy, wound healing, body implants, manufacturing of contact lenses, cosmetics and so on. Crocodile blood has focus of two main areas (Anonymous, 1995). A novel human/crocodiles hemoglobin initially called ‘Hb Scuba’ is expected to improve the ability of artificial blood products to transmit oxygen to tissues and blood as a possible derivative of antibiotic drugs. The studies may be able to create a new generation of antibiotics for a wide range of bacteria, viruses including HIV, fungi and topical application on wounds (Britton, 2005 and Reuters, 2005). Crocodile blood for potential human antibiotics and artificial blood products that transmit oxygen to tissues, and cartilage as a substitute for shark cartilage. In Thailand, crocodile blood is dried and placed into capsules for export to China.

Gallstone considered as valuable medicine, the gallstones of masques (*Macaca mulatta* and *Macaca rhesus*) have febrifugal, anti-spasmodic, purifying, anti-oedematic, cough-releiving and anti-asthematic properties. The male musk – bear (*Moschus moschciferus*) and civet (*Viverriculala malaccensis*) in traditional Vietnamese medicine for treatment of neurasthenia, giddiness, coma and certain accular ailments. In many Asian countries, bear’s bladder considered as very powerful tool against digestive illnesses. The gall is the component of ointment for treatment of carbuncles. Crocodile gall bladder expectorant pill is a product currently manufactured in China and sold around the world. The main ingredient of this product is bile crocodile and snake with other herbal and natural ingredients, and the product claims to be effective in assisting with severe coughing, sputum, sore throats, laryngitis and chronic and acute bronchitis (Anonymous, 2003). Now a day bio prosthetic materials used in various cardio-throracic repair and replacement procedures and in spite of their excellent performance and low thrombogenicity, have a tendency to fail due to degeneration and calcification characteristics. The Kangaroo pericardium as an alternative for other bio-prosthetic materials in cardiac surgery, was in the final stages of product development and its commercialization (Neethllng *et al*., 2002). Similarly the aortic valves leaflets of kangaroo valve leaflets are superior to porcine valve leaflets as far as calcification is concerned (Neethling *et al*., 2000). Research showed that budding stag or deer antlers increased appetite, were sleep inductive, reduced feelings of fatigue, increased diuresis, help the movements of the intestine & the stomach, increased digestion of proteins & fats and enhanced healing process of wounds & sores. There is a pharmaceutical product in the USSR called "Pantocrine" made from budding stag antlers is recommended as a general tonic. Anti-angiogenic agents (AAA) also found in crocodile, emu, ostrich, camel, kangaroo and deer cartilage, and in the crocodile industry, bones market appeared to be most profit making (Harper *et al*., 2000) as crocodile is a potential substitute for shark cartilage with the discovery of mercury in shark cartilage[25]. Kangaroo cartilages from the sternum and the ribs have bioactive properties as an anti-cancer or anti-arthritic.

Immunoglobulin isolated from eggs are utilized to maintain human health or for diagnostic purposes. Certain lipophilic components of the egg yolk are used as a surface-active agent in the pharmaceutical industry. Fractions isolated of the egg albumen components and peptides were used for anti-microbial and/or antiviral agents (Losnedahl *et al*., 1996). Chitosan present in emu eggshell also found in the exoskeleton of marine shellfish such as shrimp and crab (Anonymous, 2003). In addition to cholesterol lowering function, chitosan blocks the absorption of vitamin K, which aids blood clotting, and contains antibacterial properties that may alleviate high blood pressure (Teel, 2000). An industry source reported receiving an order from the USA for emu eggshell for use to manufacture pressure bandages (Anonymous, 2004a). The difference between the poison and a drug is generally a matter of dose thus dilute toxins were used as medicine for thousands of the years. Phyllomedusinae, sub-family of family Hylidae, comprises 56 species of frogs & toads have proved to be a rich source of peptides with cytolytic activity. These peptides may be identified as: (a) dermaseptins, (b) dermatoxins, (c) phylloxins, (d) phylloseptins, and (e) Gly-Leu-rich peptides (Nicolas and Amiche, 2006).

The chemicals, found in the skin of different species of frogs and toads, were the process of refinement for use of human medicine. The tricolor dart-poison frog (*Epipedobates tricolor*) produces a skin secretion that acts as a non-addictive pain killer 200x more effective than morphine. Peptides extracted from the scraped secretions of *P. bicolor* used to treat depression, stroke, seizures and cognitive loss in ailments such as Alzheimer's disease (Amato, 1992). Gawade (2006) reported amphibian skin toxins, samandarine, batrachotoxin and pulmiliotoxins used as a sodium channel blocker, activator and modulator, respectively to study the function of sodium channel. Peptides called bombenins isolated from this toad genus Bombina possess antimicrobial activities (Simmaco *et al*., 1991). These peptides, which were also present in the frog's stomach (Moore *et al*., 1991), exhibited microbicidal activity against a wide variety of Gram-positive and Gram-negative bacteria as well as against some yeasts and protozoa. Amphibians compound were also a source of anticancer or antiviral drugs (Lazarus and Attila, 1993). Magainins from Xenopus laevis skin were active against a range of human lung

cancer (Ohsaki *et al*., 1992) and other tumor (Cruciani *et al*., 1991) cell lines, and gaegurin-6 from the skin of Rana rugosa was active against multi-drug resistant human breast cancer cell lines (Kim *et al*., 2003). Conlon *et al*. (2003) identified a melittin- related peptide in the skin of Rana tagoi which was strongly cytolytic towards mouse EL4 T-Iymphoma-derived cells (LC_{50} ¼ 14 mM) and human HeLa cervical cancer-derived cells (LC_{50} ¼ 8 mM). Snake poison has been screened for its pharmaceutical value against hematological diseases like piscivostatin, flavocetin-A, platelet aggregation inhibitors; bothro-jaracin (a thrombin inhibitor), pseutarin and group III prothombin activator (Launet, 1993). Phyto-oxidised snake venom product generated by UV radiation in the presence of methylene blue, proved for their analgesic, anticoagulant properties, antidepressant, neotropic have been under investigation (Gawade, 2006). A component of snake venom (*Bothrops jararaca*) is inhibitor of angiotensin-converting enzyme (ACE) which is responsible for blood pressure (Harvey, 1995). Currently, ACE inhibitors like captopril, enalapril, and lisinopril are in the top twenty-bestselling medicines in the world.

Fat of Neotropical rattlesnake (*Crotalus durissus*) is used for rheumatism, different part of Rattlesnake (*Crotalus* sp.) were used for infirmities ranging from boils to bronchitis, in Sierra Madre people use to say "The more poisonous the animal, the more potent its antipoison" (Werner, 1970). Fu-anntai, an anticancerous drug, which has antiblastic effects on cervical carcinoma, stomach cancer, rhinocarnoma and leukemia cells,was extracted from the sea snakes (SCI EDU, 2000). Keluoqu tablets from Chinese cobra neurotoxin, analgesic from king cobra and *Vipera lebentina* considered as a very strong medicine to liquidate spots, traces of mange and measles. Snake venoms also contain peptides with antihaemorrhagic properties. These include textilinin, a novel antifibrinolytic serine protease inhibitor from common brown snake (*Pseudonaja textilis*) venom that is now in preclinical development as a novel anti-bleeding product for use in open-heart surgery (Q70033; QRxPharma). Many of the wide range of haemostatic factors found in snake venoms have been used in the development of laboratory diagnostics (for example, those produced by Pentapharm Ltd and Gradipore) to measure levels of fibrinogen, prothrombin, blood-clotting factors and protein C associated with haemostatic disorders.

Venom peptides might also prove useful in the development of novel treatments for hypertension (ρ-conopeptides) and atrial fibrillation (GsMTx-4). The ρ-conopeptides wereselective, non-competitive inhibitors of the α 1-adrenoceptor. GsMTx-4 from the tarantula *Grammostola spatulata* is a novel blocker of mechanosensitive ion channels that inhibits atrial fibrillation (Bode *et al*., 2001). Digestive enzymes including salvia have also useful for the treatment of many human diseases. An anticoagulant property of tick salvia as a model agent to prevent undesired blood clotting (Jones, 1998). Leech antiplatelet protein Bivalirudin is an inhibitor of collegen-induced platelet aggregation and stop blood clotting is a new, genetically engineered substance in the saliva of the leech (*Haementeria officinalis*) (Gladwell, 2002). Glucagon-like peptide-1 (GLP1) is an insulinotropic hormone secreted from endocrine cells of the small and large intestine in a nutrient-dependent manner. GLP-1 inhibits gastricemptying and food intake, and controls blood glucoselevels.

A GLP-related peptide, exendin-4 from the venom of the Gila monster *Heloderma* suspectum has been shown to be active in vivo. Surprisingly, GLP-related peptides, including exendin-4, share structural homology to α-latrotoxin from the black widow spider (Keating, 2005) and might have potential in the treatment of Alzheimer's disease (Perry and Greig, 2002). Tetrodotoxin (TTX) a bioactive water-soluble guanidinium derivative compound produced by puffer fish resembles procaine inhibit transmission of nerve cells (Colwell, 1997). Other toxins isolated include ciguatoxin from electric rays, which was served as a potent antidote for pesticide poisoning (Oliviera *et al*., 2003). TTX isolated from puffer fish and many other marine organisms has become a useful tool for researchers studying the voltage-gated sodium channel (Auyoung, 1999). The *Conus* species has evolved deadly nerve toxins and some of the conotoxins block channels regulating the flow of potassium or sodium across the membranes of nerve or muscle cells; others bind to N-methyl-D-aspartate receptors to allow calcium ions into nerve cells; and some are specific antagonists of acetylcholine receptors responsible for muscle contraction.

Thus, conotoxins are valuable probes in physiological and pharmacological studies. A team of researchers from the University of Melbourne extracted the conotoxins from a cone-shell snail which inhibited pain (as being 10,000 times more powerful than morphine), and accelerated the recovery of injured nerves (Holmes, 2002). The absolute stereochemistry of membrenones A–C, -dihydropyrone-containing polypropionates isolated from the skin of the Mediterranean mollusc , *Pleurobranchus membranaceus* (Ciavatta *et al*., 1993) has been determined by stereo controlled synthesis of the enantiomers (Sampson and Perkins, 2002). The first synthesis of siphonarin-B has confirmed the absolute stereochemistry of the metabolite (Paterson *et al*., 2002) isolated from the molluscs *Siphonaria zelandica* and *S.atra* (Hochlowski *et al*., 1984). Bursatellanin-P, a 60-kDa protein exhibited anti-HIV activity was purified from the purple ink of the sea hare, *Bursatella leachii*. The first total syntheses of aplyolides B–E, ichthyotoxic macrolides isolated from the another species of skin of sea hare *Aplysia depilans* (Spinella *et al*., 1997), have confirming the absolute stereochemistry reported for the metabolites (Spinella *et al*., 2002 and Caruso Spinella, 2002).

Indian and natives of other part of the world use milk as food and for diseases therapy. Camel milk contains lower fat and lactose, higher levels of potassium, iron and vitamin C and large concentrations of insulin, therefore, used traditionally to treat diabetes (Hamers-casterman *et al*., 1993 and Hull, 2004), dropsy, jaundice, problems of the spleen, tuberculosis, asthma, anemia, and piles (Rao *et al*., 1970), other lung ailments and in the treatment of tuberculosis (Akhundov *et al*., 1972). Wernery (2006) reported that camel milk also cures autoimmune diseases such as multiple sclerosis, Crohns disease, psoriasis, lupus, pemphigus, allergic asthma, rash, diabetes, stress induced peptide ulcer, infectious disease like tuberculosis and serves as booster of the immune system. Lotion and creams with camel fat may also protect against skin cancer. Camel lgG has full neutralizing activity even against the tetanus toxin as it-enters the enzyme structure. Camel hyperactive variable regions have increased the repertoire of antigen binding sites (Muyldermans *et al*., 2001).

A camel variable domain antibody fraction is a - potent and selective inhibitor of the hepatitis C enzyme system (Martin *et al*., 1997). Bee honey has proved to be very important source of drugs for modern medicine due to immunological, analgesic, antibacterial, diuretic, anesthetic and anti- rheumatic properties (Yamakawa, 1998). The predominant acid found in honey is gluconic acid. Honey also contains a number of amino acids, proline, phenylanine and aspartic acid with a concentration of greater than 200 ppm (Bosi and Battalgllni, 1978). The main enzymes found in honey were glucose oxidase; and amylase (diastase) and glucose oxidase has microbicidal property. Pure honey has bactericidal activity against many enteropathogenic organisms, including those of the Salmonella and Shigella species and enteropathogenic *E. coli* (Jeddar *et al*., 1985). Dolo *et al*. (1937) called 'inhibine' to the substance and antibacterial activity was due to hydrogen peroxide (Adock, 1962 and White and Subers, 1963). Bogdanov (1983) extracted a substance belonging to the group of flavonoids for their antibacterial capacity from honey. In vitro studies of *Helicobacter pylori* isolate that causes gastritis, inhibited by a 20% solution of honey. Even isolates that exhibited a resistance to other antimicrobial agents were susceptible (Ali *et al*., 1991).

Non-dissociated organic acids also play a role in the antimicrobial activity of honey (Ingram *et al*., 1956 and Macris, 1975) since they were highly soluble in cell membranes (Cramer and Prestegard, 1977) and induce alterations in the cellular permeability and in oxidative phosphorylation (Freese *et al*., 1973). There are more than 30 prospective animal industries in world, which include native, feral and domesticated animals and these industries relied on only a few products for their income (Bodger and Goulding, 2003). Thus animal like seahorses and their pipefish relatives have been threatened directly by expanding trade of traditional medicines, aphrodisiacs, aquarium fishes, foods and curious and indirectly by the destruction of habitats. Inedible by-products such as blood fractions gall, splenic fluid and insulin provide raw material for medical and pharmaceutical industries. High demand of the medicinal animal species in markets now needs protection globally, under national or international legislation. The National Action Plan to Strengthen the Control of Trade in Wild Fauna and Flora, 2010 (Anonymous, 2004a) deals with tackling these issues. The records of over 180 animals of medicinal value in different part of world itself are a strong evidence of the medicinal use of wildlife resources (Costa-Neto, 2004).

Thus, activity should be performed in a way that human needs and protection of biodiversity be guaranteed (Andriguetto-Filho *et al*., 1998) and it should be viewed within its cultural dimension (Costa-Neto, 1999a), which includes the way people perceive, use, allocate, transfer, and manage their natural resources (Johannes, 1993). Species those directly involved in traditional medicines should be among the highest priorities for conservation (Kunin and Lawton, 1996). Recovery of endangered species should be attempted using scientific techniques in traditional farming systems (Costa-Neto, 1999b). Animals bred in captivity for medicinal purposes are a new frontier of economy. Opportunity to animal farming of medicinal uses will open possibilities to increasing employment opportunities, independent self-help groups, PPP (Public – Private Partnership) models, and entrepreneurship. Above all it will strengthen the value chain and necessary infrastructures at various levels of advancement. Legislative inclusion, clear guidelines and technical support shall help investors, and manufacturers to come up with buy-back promises to rural cultivators. This shall not only reduce the financial burden of the government but, also directly revive the rural economy. During last few decade bio-resources utilization particularly animals have not been given full awards and people gain their benefits without paying for them in terms of various angle. Ehrlich (1992) point out that biotic diversity should be valued in term of ethical, esthetical, direct economic, and indirect economic. In recent years, for sustainable development cultural prospective always taken in to the consideration (Morin-Labatut and Akhtar, 1992). Manufacturers need sustainable supplies of animal and their by-products at considerable prices to produce affordable medicines for human being. Secondary industry, medicines for animal will have a direct impact and growth prospects when the efforts are being made to produce good quality raw materials – animal and their by-products. Scope content is very high for everyone at all level of people including both skilled and unskilled, entrepreneurs, investors and government.

We can classify these industry into three major sectors one, cultivation of animal of medicinal use, second, manufacturing of animal based medicine for mankind and third, production of medicine / supplements to ensure healthy and safe animals as raw material to industries. Biosecurity is one of the important prevention on health hazard to both humans and animals. Effective implementation of good manufacturing practices and biosecurity will help to produce not only healthy and good animals but also, provide umbrella of protection against spreading of identified and unidentified diseases some of them can be life threatening within local communities. It's like insuring your wealth and life. India have blessed with 7.31% animal species of the global fauna. However, not much work has been done for medicinal use of domestic animals and their conservation. Ethnic communities widely use animals and their products in traditional medicines, because they live in villages where animals of medicinal value are easily available. This interest goes farther when one takes into consideration the benefits that animal-derived compounds give in terms of monetary value and human welfare.

Conclusion

While emphasizing usability of animal and animal by-products in manufacturing of medicines for the common interest of mankind, following consequences can be considered.

1. Bio-resources should be priced appropriately to benefit society as a whole and not merely taking advantage of exploitation of bio-resources for free benefiting the present generation and loss to the future generation.
2. Environmental conversation program to be designed and rolled out to protect human needs and bio-diversity within cultural dimensions.
3. Legislative inclusions and control measures to be laid down to restrict overexploitation of the bio-resources, species, etc. i.e., the rate of extraction of the source should not exceed the rate of renovation of the same source.
4. Preservation programs for diminishing species, especially species identified for the medicinal use as well as required

for ethical sake, intellectual property rights of the primary owners of the folk knowledge, useful animals, sustainability of the deployed resources.

5. Fact that the species once diminished due to our wrong practices cannot be evolved again for the reasons contributable to violation of point 3 above cannot be overlooked.
6. Further research and development of the animal based medicines to be done to ensure commercial scalability for affordable solutions to human being.
7. Guidelines and standardization of the medicinal formulation for commercialization and affordable solutions to mankind.
8. Commercialization of animal based medicine within secured framework has enormous potential for employment, investors, entrepreneur, science and technological development.
9. Inclusion of Zootherapy for mankind in the "Make in India" shall be instrumental in developing new legacy for India.

REFERENCES

Adock, D. 1962. The effect of catalase on inhibine and peroxide values of various honeys. *J. Apic. Res*.; 1 :38- 40.

Akhundov, A. A., Dyrdyev, B. and Serebryakov, E.R. 1972. Effect of combined treatment on water electrolyte exchange in pulmonary TBC patients. Zdravookhr. Turkm. 16: 40-44.

Ali, AT, Chowdhury, M.N. and Ai-Humayyd, M.S. 1991. Inhibitory effect of natural honey on Helicobacter pylori. Tropical Gastroentero/. 12:139-143.

Amato, I. 1992. From 'hunter magic', a pharmacopoeia? Science 258: 1306.

Andary, C., Motte-Florace, E., Ramos-Elorduy, J. and Privat, A. 1996. Chemical Screening: updated methodology applied to medicinal insects. In 3rd Europian colloquium on Ethonopharmacology, 5., and International Conference on Anthropology and history of Health and Disease 1., genova. Abstract. Genova; Erga Edizione 1996, CD-ROM.

Andriguetto-Filho, J. M., A. C. Kroger, and M. B. Lange. 1998. Caca, bio- diversidade e gestao ambiental na Area de Protecao Amblental de Guaraquecaba, Parana, Brasil. Biotemas 11(2): 133- 156.

Anonymous, 1995. Blood Substitutes: elements of crocodile hemoglobin used to engineer new molecule, 6 March 1995: 2-3, <http://www.NewsRx.net>, viewed September 2003.

Anonymous, 1995. Materia Medica commonly used in China. Beijing: Science Press; pp162.

Anonymous, 2003. Proceeding of the International Conference on Network Research, conservation, use and sustainable development of biological resources for Medical purposes in Vietnam from 27-29 March 2002. In Vietnamese.

Anonymous, 2004a. Industry interviews for crocodile, emu, goat, kangaroo and rabbit industries, October 2004 – February 2005, Department of primary industries and fisheries, Queensland.

Auyoung, E. A. 1999. Brief history and overview of Tetrodotoxin (TTX). MCB165-Molecular Neurobiology and Neurochemistry, 1-2.

Bode, F., SACHS, F. and FRANZ, M. R. 2001 Tarantula peptide inhibits atrial fibrillation. Nature 409, 35–36.

Bodger, J and Goulding, B. 2003. Distribution of meat products from prospective Australian animal industries: crocodiles, emus, game birds, rabbits, hares and snails, RIRDC Publication no. 03/023, Rural Industries Research and Development Corporation, Canberra.

Bogdanov, S. 1983. Characterisation of antibacterial substances in honey. Lebensm Wissc Techno/17:74- 76.

Bosi, G and Battalgllni, M. 1978. Gas chromatographic analysis of free and protein amino acids in some unifloral honeys. *J Apic Res* 17:152-166.

Britton, A. 2005. Crocodilians: natural history and conservation: Recent news, <http://www.crocodilian.com>, viewed September, 2005.

Caruso, T. and Spinella, A. 2002. First total synthesis of natural aplyolides C and E, ichthyotoxic macrolides isolated from the skin of the marine mollusc Aplysia depilans. Tetrahedron- Asymmet. 13: 2071-2073.

Chen Yongzeng, 1995. Chinese Medicine Information (AnGuo city) 10:5.

Ciavatta, M. L., Trivellone, E., Villani, G., Cimino, G. 1993 Membranines: new polypropionates from the skin of the Mediterranean mollusk *Pleurobravchus membranaceus*. Tetrahedron Lett. 34: 6791- 6794.

Colwell, R. R. 1997. Microbial biodiversity and biotechnology. In M. L. Reaka-Kudla, D. E. Wilson and E. O. Wilson (eds.), Biodiversity II: Understanding and Protecting our Biological Resources, Washington, D.C.: Joseph Henry Press 77-78.

Conlon, J.M., Sonnevend, A., Patel, M., Vijayasarathy; C., Nowotny, N., Zilahi, E., Iwamuro, S., Nielsen, P. F., PA·L, T., 2003. A melittin-related peptide from the skin of the Japanese frog, Rana tagoiwith antimicrobial and cytolytic properties. *Biochem. Biophys. Res. Commun*. 306: 496-500.

Costa-Neto, E M. 1999a. Recursos animais utilizados na medicina tradi- cional dos Indios Pankarare r que habitam no nordeste do estado da Bahia, Brasil. Actualidades Biol6gicas 21 (7): 69-79.

Costa-Neto, E. M. 1999b. Healing with animals in Feira de Santana city, Bahia, Brazil. *Journal of Ethnopharmacology* 65: 225-230.

Costa-Neto, E.M. 2004. Implications and applications offolk zootherapy in the State of Bahia, Northeastern Brazil. Sust. Dev. 12: 161-174.

Cramer, J.A. and Prestegard, J.H. N.M.R 1977. Sudies of pH induces transport of carboxylic acis across phospholipid vesicle membranes. Biophys. Res. Commun. 75:295-301.

Cruciani, R.A., Barker. J.L., Zasloff, M., Chen, H.C., Colamonici, 0., 1991. Antibiotic magainins exert cytolytic activity against transformed cell lines through channel formation. *Proc. Natl. Acad. Sci*. USA 88: 3792-3796.

Dolo, H, Du. O.H. and Dziao, S.T. 1937. Nachweis antibakterieller, itze d'lichtempfindlicher

Ehrlich, P. R and Ehrlich, A. H. 1992. The value of biodiversity. Ambio 21(3): 219-226.

Freese, E., Sheu, C.W. and Galliers, E. 1973. Function of lipophilic acids as antimicrobial food additive. *Nature* 241:321-325.

Gawade, S. P. 2006. Threrapeutic alternatives from venom and toxins. 34th Annual Conf. Indian Pharmarological Society Jaipur, Dec. 21~23 2006. pp S81.

Gillispie, C.C., (Editor): Dictionary of Scientific Biography. NewYork: Charles Scribner's Sons. (1970–1978): 1973. VI:418–431,1972:V:119–122, 1975: XII:229–231; 1978: XV:261–267; 1975:XI:230–233; 1970:III:548–549.

Gladwell, T.D. 2002. Bivalirudin: A direct thrombin inhibitor. Clin. Ther. 24: 38 - 58.

Hakim, M. 1949. Hamdard Pharmacopoeia of Eastern Medicine, Karachi: Hamdard; 1970:vii.

Hamers-casterman, Atarouch, C.T., Muyldermans, S. Bandolman, N. and Hamer, R. 1993. Naturally occuring antibodies devoid of light chains. Nature 363: 440- 448.

Harper, G., Allingham, P. G. and Qiu, X. 2000. Cartilage co-products: commercial development from alternative production species, RIRDC Publication no. 00/35, March 2000, Rural Industries Research and Development Corporation, Canberra, pp 103.

Harvey, AL. 1995. From venoms to toxins to drugs. Chemistry & Industry. Available at: http://ci.mond. org!. 952214htm/.

Hochlowski, J. E., Coll, J. C., Faulkner, D. J., Biskupiak, J. E., Ireland, C. M., Zheng, Q. T., He, C. H., Clardy, J.1984. Novel metabolites of four Siphonaria species. *J. Am. Chem. Soc*.106: 6748-6750.

Holmes, I. 2002. Snail toxin could ease chronic pain. Nature Science Update. March 29.

Hull, S.J. 2004. Camel's milk to treat diabetes http://www. diabetes. org. uklnews/ dec04/camel.

Ingram, F.J., Ottoway, H. and Coppock, J. E. 1956. The preservative action of acid substances in food. *Chem. Ind*. 42:1154-1163.

Ireland, C., Copp, B., Foster, M., Mcdonald, L., Radisky, D., Swersey, J. 1993. In Marine Biology. Attaway, D., Zeborsky, O., Plenum Press: New York, Vol I, p 1-43.

Jeddar, A, Kharsany, A., Ramsaroop, U. G., Bhamjee, U. G., Haffejee, I. E. and Moosa, A. 1985. The antibacterial action of honey: an in vitro study. South Africa Med. 67:257-258.

Johannes, R.E.1993. Integrating traditional ecological knowledge and management with environmental impact assessment. In J. T. Inglis (ed.), Traditional Ecological Knowledge: Concepts and Cases, 33-39. Ottawa: International Program on Traditional Ecological Knowledge and International Development Research Centre.

Jones D 1998. The neglected saliva; medically important toxins in the humen lice. Parasitology 116: 973-981.

Keating, G.M. 2005. Exenatide. Drugs 65: 1681 - 1692.

Kim, S., Kim S.S., Bang, Y.J., Kim S.J. and Lee, B.J. 2003. In vitro activities of native and designed peptide antibiotics against drug sensitive and resistant tumor cell lines. Peptides 24: 945-953.

Kunin, W. E. and Lawton, J. H.1996. Does biodiversity matter? Evaluating the case for conserving species. In K. J. Gaston (ed.), Biodiversity: A biology of Numbers and Difference, Oxford: Blackwell Science. 283-308.

Launet, E. 1993. Dan's les fOrets, a la recherche des medicaments de demain. Science et Vie 904: 86-91.

Lazarus, L. H. and Attila. M.1993. The toad, ugly and venomous, wears yet a precious jewel in his skin. Progress in Neurobiology 41: 473-507.

Losnedahl, K.J., Wang, H. and Aslam, M. 1996. Antimicrobial proteins in milk. *J. Diary Sci*. 84: 1123- 1127.

Macris, B.J. 1975. Mechanisms of benzioc acid uptake by Saccaromyces cerevisiae. Appl. Microbiol. 30: 503- 506.

Martin, F, Volpari, C., Steinkuhler, C. and Dimas, N.1997. Affinity selec- tion of a camelized V (H) domain antibody inhibitor of hepatitis C virus NS3 protease. Protein Eng. 10: 607-14.

Moore, K. S., Bevins, C. L., Brasseur, M. M., Tomassini, N., Turner, K., Eck, H. and Zasloff, M. 1991. Antimicrobial peptides in the stomach of Xenopus laevis. *J. Biol. Chem*. 266: 19851–19857.

Morin-Labatut, G. And Akhtar, S. 1992. Traditional environmental knowl- edge: A resource to manage and share. Development 4: 24-30.

Morris, S.A., De Silva, E.D. and Anderson, R.J. 1990. Chromodorane diterpenes from the tropical dorid nudibranch Chromocloris cavae. *Canadian J. Chem*., 69: 768-771.

Muyldermans, S, C. Cambillau, C. and Wyns, L. 2001. Recognition of antigens by single-domain antibody fractions: the superuuous luxury of paired domains. *Trends Biochem. Sci.* 26: 230-5.

Neethling, W. M., Papadimitriou J. M., Swarts, E. and Hodge, A. J. 2000. Kangaroo versus porcine aortic tissue valve geometry morphology, tensile strength and calcification potential, *Journal of Cardiovascular Surgery*, 41 (3): 341-348.

Neethllng, W. M., Cooper S., Van Den Heever, J.D., Hough, J. and Hodge, A.J. 2002. Evaluation of Kangaroo pericardium as an alternative substitute for reconstructive cardiac surgery. *Journal of Cardiovascular Surgery*, 43 (3) : 301-306.

Nicolas, P. and Amiche, M., 2006. The Dermaseptins. In: Kastin, A.J. (Ed.), Handbook of Biologically Active Peptides. Elsevier, San Diego, pp. 295–304.

Ohsaki, Y., Gazdar, A.F., Chen, H.C. and Johnson, B.E. 1992. Antitumor activity of magainin analogues against human lung cancer cell lines. *Cancer Res*. 52: 3534-3538.

Oldfield, M.L. 1989. The Value of Conserving Genetic Resources. Washington D.C.: National Park Service, pp 375.

Oliviera, J. S. Pires Junior, O. R. Morales, R.A.V. Bloch Junior, C.; Schwartz, C. A. Freitas, J. S. 2003. Toxicity of Puffer fish- two species (*Lagocephalus laevigatus*, linn. 1766 and *Sphoeroides spengleri*, Bloch 1785) from the southeren Brazilian coast. *J. Venom. Anim. Toxins Incl. Trop*. 9: 76-82.

Paterson, I. Chen, D. Y. K. Franklin, A. S. 2002. Total Synthesis of Siphonarin B and Dihydrosiphonarin B. Org. Lett. 4: 391-394.

Pemberton, R. W. 1999. Insect and other Orthropods used as drugs in Korean traditional medicine. *J. Ethonopharmacology* 65 : 207-216.

Perry, T. and Greig, N. H. 2002. The glucagon-like peptides: a newgenre in therapeutic targets for intervention in Alzheimer's disease. *J. Alzheimers Dis*. 4, 487–496.

Pettit, G.R., Kamano, Y., Dufresne, C. Cerny, R.L., Herald, C.L. and Schmidt, J.M. 1989. Isolation and structure of the cytostatic linear depsipeptide dolastatin 15. *J. Am. Chem. Soc*. 54: 6005- 6006.

Powell, A.M. 1993. Drugs and pharmaceuticals in ancient Mesopotamia. In The Healing Past Edited by: Jacobs I, Jacobs W. Leiden: Brill: 47-50

Rao, M.B., Gupta, R. C. and Dastur, N. N. 1970. Camel's milk and milk products. *Indian J. Dairy Science* 23: 71-78.

Rao, M.B., Gupta, R. C. and Dastur, N. N. 1970. Camel's milk and milk products. *Indian J. Dairy Science* 23: 71-78.

Reuters, 2005. Antibiotics from crocodile blood? Wired News, <http://www.wired.com/news/medtech/0,1286,68553,00.html?tw=wn_tophead_7>, viewed.

Reynolds, J.W. and W. M. Reynolds, 1972. Earthworms in medicine. *American J. Nurs*1.72:273.

Riddle, J.M. 1987. Folk tradition and folk medicine: Recognition of drugs in classical antiquity. In Folklore and Folk Medicine Edited by: Scarborough J. Madison. Wis.: American Institute of the History of Pharmacy: 60.

Rorsener, J.A. and Scheuer, P.J. 1986. Ulapualids A and B, extraordinary antitumor macrolides from nudibranch egg masses. *J. Am. Chem. Soc*. 108: 846-847.

Sampson, R. A. and Perkins, M.V. 2002. Total Synthesis of (-)-(6S, 7S, 8S, 9R, 10S, 2'S)-Membrenone- A and (-)-(6S, 7S, 8S, 9R, 10S)-Membrenone-B and Structural Assignment of Membrenone-C. Org Lett. 4: 655-1658.

Schnapp, D., Kemp G.D. and Smith, V.J. 1996. Purification and characterization of a proline-rich anti-bacterial peptide, with sequence similarity to bactenecin 7, from the haemocytes of the shore crab, *Carcinus maenas*. *Eur. J. Biochem*. 240: 532-539.

Sci EDU. 2000. New cancer Drug extracted from marine organism. People's Daily 1-4.

Shrivastava, S.K., Shrivastava, A.C., Prakash, A. and Rao, J. 2013. Zootherepy for Mainkind from Medieval age to Modern era. Applied Zoologist Research Association (AZRA), Division of Crop Protection CRRI (ICAR), Cuttack, India.

Simmaco, M., Barra, D., Chiarini, F., Noviello, L., Melchiorri, P., Kreil, G. and Richter, K. 1991. A family of bombinin-related peptides from the skin of Bombina variegata. European. *J. Biochem*. 199: 217–222.

Spinella, A. Caruso, T. and Coluccini, C. 2002. First total synthesis of natural aplyolides B and D, ichthyotoxic macrolides isolated from the skin of the marine mollusk Aplysia depilans. Tetrahedron Lett. 43:1681-1683.

Spinella, A. Zubía, E. Martinez, E. Ortea, J. and Cimino, G. 1997. Structure and stereochemistry of aplyolides A-E, lactonized dihydroxy fatty acids from the skin of the marine mollusk Aplysia depilans. *J. Org. Chem*. 62: 5471-5475.

Teel, G. 2000, Dietician disputes fat-busting promise: pill blocks absorption ot'vital vitamins, Calgary Herald, 12 June 2000. Alberta, Canada.

Thompson, R.C. 1923. Assyrian Medical Texts. Oxford: Oxford University Press.pp212.

Werner, D. 1970. Healing in the Sierra Madre. Natural History 79(9): 61- 66.

Wernery, Ulrich. 2006. Camel milk, The white gold of the Desert. *Journal of Camel Practices and Research* 13 (1): 15-26.

White, J. W and Subers, M. H. 1963. Studies on honey inhibine, a chemical assay. *J. Apic. Res*. 15: 23-28.

Yamakawa, M. 1998. Insect antibacterial proteins; regulatory mechanisms of their synthesis and a possibility as new antibiotivs. *J. Seric. Sci*. Japan 67:163-182.

Zhang, F. X., Guo, B. Z. and Wang, H. Y.1992. The effects of earthworm extract and its effective constituents. Soil Biology & Biochemistry 24 (12): 1247-1251.

****