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# CHEMICAL CONSTITUENTS AND BIOLOGICAL ACTIVITIES OF A MANGROVE PLANT ACANTHUS ILICIFOLIUS – A REVIEW.

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## Abstract:

*Acanthus ilicifolius* generally known as Sea holy and holy mangrove. The plant has enormous biological value and plant utilized as elective medication to treat- various diseases. In this article, we attempted to give the current data on phytochemical constituents, therapeutic uses and anti-microbial, anti-inflammatory, anti-diabetic activities and other biological activities of *Acanthus ilicifolius*. This paper gives an outline on covering the biology, and various commercial and therapeutic applications. The extract of different parts of *Acanthus ilicifolius* indicated huge pharmacological activities so it is important to perform advance investigation to isolate such pharmacological active compounds which can be used for treating different diseases.

**Index Terms:** *Acanthus ilicifolius*, Holy mangrove, Biological activities.

## I. Introduction:

*Acanthus ilicifolius* is a perpetual herbaceous plant, prevalently perceived as "Holy leaved acanthus". The plant regularly lives in regions of unobtrusive saltiness, shaping shrub around mangrove palms. For the most part, the plant is used in standard systems of medicine, including traditional Indian remedy or Ayurveda and standard Chinese medication [1, 2] for treating various sicknesses. Various parts of the plant have been used as unpleasant medicine for treatment of asthma, diabetes [3, 4] the composing revealed that the plant is well off in bioactive compounds.

## II. Environment and Geographical Distribution:

*A.ilicifolius* is regular in estuaries all through Asian tropics from India to Polynesia and northern Australia. Asia and Australia have the best assortment and conveyance of mangrove species known to mankind. In India, it is found ordinarily in the east and west drifts, likewise in Meghalaya and the Andaman. It is a genuine mangrove animal group found in the most foreshore area. It typically develops on waterway banks or tidal channel sides or low swampy zones in mangrove woodlands and regions [5]

### 2.1. Taxonomy:

**Class:** Dicotyledones
**Subclass*:*** Gamopetalae
**Series*:*** Bicarpellatae
**Order*:*** Personales
**Family*:*** Acanthaceae
**Genus*:*** *Acanthus*
**Species*:*** *ilicifolius*

From Greek word '*Acantha*', *Acanthus'* is derived which means thorn or thistle, referring to some species have spiny leaves. The word '*ilicifolius*' refers to holly-like leaves from the Latin word '*ilex'*.

### 2.2 Common Names:

English- Holy Mangrove
Bengali - Harkuchkanta, Kentki
Hindi- Hargoza
Kannada- Mulluchulli
Sanskrit- Harikusa
Tamil- Kaludaimulli
Telugu- Alasyakampa

### 2.3 Morphological Description:

Shrub grows up to 2 meter tall robust mangrove areas, Aerial roots-stilt roots; Leaves-simple, opposite, lanceolate, narrowed at base, serrate margins armed with spines; spines longer in flowering season; petiole short, 5 to 6 mm in length, slightly winged with two sharp spurs at the base; color dark green when fresh, yellowish-brown on drying. Odor-indistinct, taste bitter. Flowers-sessile, 4 cm long, spike inflorescence, terminal, corolla light blue or violet; Fruit-capsule, ovoid–oblong, up to 3 cm long, compressed, apiculate, brown, shining.

**Fig. 1: Inflorescence of** *Acanthus ilicifolius*

## III. Chemical Constituents and Biological activities:

Phytochemical investigation of *A.ilicifolius* indicated the presence of alkaloids, glycosides, triterpenoids, saponins, flavonoids, steroids, fatty acid derivatives and. List of Phytochemicals are shown in Table 1[6].

Table 1: Chemical compounds reported in *Acanthus ilicifolius*

| Plant part | Type of extract | Compounds isolated |
|---|---|---|
| Powdered plant material | Ethanolic extract | Alkaloid-Acanthicifoline[4] |
| Root | Ethanolic extract | Triterpenoid saponin[5] |
| Leaves | Aqueous Methanolic extract | 2-benzoxazolinone[6] |
| Leaves | Chloroform extract | Pentacyclic triterpenoids and sterols[7] |
| Leaves | Ethanolic extract | Methylapigenin 7-o-β-D-glucuronate-Flavone glycosides[8,9] |
| Leaves | Methanolic extract | Bisoxazolinone[10] |
| Aerial part | Methanolic extract | Lignan and Cyclolignan glycosides[11,12] |
| Pods | Methanolic extract | 1,4-benzoxazinone[13] |
| Dried aerial part | Methanolic extract | Benzoxazinoid glucosides[14] |
| Dried aerial part | Ethanolic extract | Aliphatic alcohol glycoside-ilicifolioside C and two Z-4-coumaric acid glycosides[15] |
| Dried aerial part | Ethanolic extract | Phenylethanoid glycosides(ilicifolioside A) and an aliphatic alcohol glycoside(ilicifolioside)[16] |
| Stem | Hexane extract | Homologous series of 15 saturated odd and even fatty acids[17] |
| Leaves | Methanolic extract | Coumaric acid derivative-Acancifoliuside[18] |
| Spiny herb | - | Megastigmane and flavone glycosides[19] |

## 3.1 Anti-Inflammatory / Free Radical Scavenging Activity:

Senthil Kumar et al, evaluated its anti-inflammatory activity, the methanolic fraction of *A.ilicifolius* leaf extract produced significant inhibition of rat paw edema, similar to a COX and LOX inhibitor, when regulated both before

and after carrageenan organization, in a way like BW755C a synthetic cyclooxygenase (COX) and lipoxygenase (LOX) inhibitor. The concentrate diminished protein exudation and leukocyte relocation in the peritoneal liquid, along these lines showing its viability towards repressing peritoneal irritation. It additionally delivered huge hindrance of COX (1 and 2) and 5-LOX movement. Pre hatching of the concentrate restrained the creation of pro-inflammatory cytokines (TNF alpha and IL-6) in lipopolysaccharide (LPS)- animated fringe blood mononuclear cells (PBMCs). The methanolic part of the concentrate was likewise found to have critical free radical (DPPH, ABTS, superoxide and hydroxyl radical) searching movement. The concentrate on intra peritoneal organization enlarged the endogenous antioxidant agent status, as obvious from the noteworthy increment of ferric decreasing capacity of plasma (FRAP) and absolute peroxyl radical catching action of plasma (TRAP). It also produced significant inhibition of COX 1and 2 and 5-LOX activity and showed critical free radical scavenging activity [7].

## 3.2 Antimicrobial Activity:

Alcoholic and chloroform extract of leaves of *A. ilicifolius* showed strong inhibitory action against *B subtilis, S aureus, C albicans, A. fumigatus and Aspergillus niger* and moderate inhibitory action against *P aeruginosa* and *P vulgaris* [8].

The ethanol extract effect was significantly higher than that produced by methanol and aqueous extracts [9]. The in vitro antibacterial and antifungal investigations of the ethanolic, butanolic and chloroform extracts of the leaves and roots were done by the Agar cup-plate method [10]. Every one of the extract was independently disintegrated in dimethylsulfoxide (DMSO) to get 10 mg/ml arrangements. Ampicillin (1 mg/ml) and clotrimazole (1 mg/ml) were utilized as standard antibacterial and antifungal specialists individually. The antibacterial activity was assessed by utilizing 24 h cultures of *Bacillus subtilis, Staphylococcus aureus, Pseudomonas aeruginosa and Proteus vulgaris* utilizing Muller Hinton Agar medium. Antifungal activity against 24 h cultures of *Candida albicans, Aspergillus fumigatus and Aspergillus niger* utilizing Sabouraud dextrose agar medium. Precisely 0.2 ml of the test and standard arrangements were moved to cups aseptically and named. The microorganism immunized plates were then kept up at room temperature for 2 h to permit the dispersion of the arrangements into the medium. The measurements of zone of restraint encompassing every one of the wells were recorded. Antibacterial and antifungal activity of the concentrates of various parts of the plant. The ethanol, butanol and chloroform concentrates of the various parts of the plant showed solid to direct activity against the test microorganisms.

## 3.3 Anti-Diabetic Activity:

G.Venkataiah, et al, evaluated the ethanolic roots extract *Acanthus ilicifolius* having the counter diabetic action in alloxan actuated diabetic rats. Glibenclamide is an antidiabetic sedate in a class of prescriptions known as sulfonylurea, firmly identified with sulfa drugs. It is utilized as standard control tranquilize for assessment of natural extracts in preclinical investigations as the standard medication to correlation of antidiabetic action of various extracts of therapeutic plants for their antidiabetic activity. After a solitary portion of concentrate the dosages of 200

mg/kg and 400mg/kg of ethanolic Acanthus ilicifolius root extract indicated a critical decrease in the glucose level in intense and repeated dose in sub-intense investigation. From the histo-pathological examinations it was proposed that the recovery of β cells following decimation by alloxan may be the essential driver for the ant diabetic movement of the extracts. There is no demolition of β cells in ordinary control group, total harm of β cells was seen in diabetic control group, and recovery beta cells was seen in all experimental groups and better recovery was seen in test-1 and test-2 when contrasted with diabetic control group for example equivalent to that of standard drug treated group. The outcomes demonstrated that the better recovery of β cells is seen in test-2 (400mg/kg) group and standard drug treated group when contrasted with diabetic control group [11].

### 3.4 Anti-osteoporotic Activity:

Osteoblasts are the bone-framing cells of the skeleton; they incorporate, direct and regulate the mineralization of the extra-cell grid of the bone. MC3T3-E1 cells, an osteoblast-like cell line, have been accounted for to hold their ability to separate into osteoblasts, and may give valuable data on the impacts of phytochemicals on the separation of osteoblasts [12]. This examination showed that mixes can expand the cell development, ALP movement, collagen substance, and calcium testimony of osteoblastic MC3T3-E1 cells, demonstrating their anabolic impact. Papoutsi et al. (2006) [13] revealed that acteoside isolated from *Verbascum macrurum* was an antiestrogen in bosom malignant growth cells however has no impact on endometrial cells. Also, acteoside caused a huge increase in the ALP action of the KS483 osteoblast cell line. In addition, treatment with ICI 182780 within the sight of acteoside abrogated its constructive outcome on the activity of ALP. Acteoside has the essential phenolic rings just as a hydroxyl bunch in the atom, which is requirements that permit the estrogen receptor (ER) and support the activity of the ER-ligand (Fang et al., 2001). This proposes acteoside upgrades the movement of ALP, to a limited extent, by means of an ER-subordinate pathway. In this investigation, acteoside (2), isoacteoside (3), and (+) - lyoniresinol 3a-O-β-glucopyranoside (5) of *A. ilicifolius* leaves had direct stimulatory consequences for bone development in refined MC3T3-E1 osteoblast cells. In like manner, *A. ilicifolius* leaves may be helpful as a pharmacological operator for the treatment of osteoporosis [14].

### 3.5 Anticarcinogenic / Tumour Reducing Activity:

Alcoholic extracts of *A. ilicifolius* is cytotoxic towards the tumor cells in 72 h measure, yet not in 3 h examine. From this we can expect that the concentrate followed up on cell cycle. In vivo antitumor examinations uncovered that the concentrate altogether (P0.001) expanded the life expectancy of ascites tumor bearing mice portion conditionally. In addition, the concentrate altogether decreased the strong tumor advancement in mice. The tumor decrease was high in animals treated at the same time with the concentrate. It was accounted for that plant derived extracts containing cancer prevention agent standards demonstrated cytotoxicity towards tumor cells [15] and antitumor activity in experimental animals [16]. Antitumor activity of these cancer prevention oxidants is either through acceptance of apoptosis [17] or by restraint of neovascularization [18]. Strangely the concentrate of A. ilicifolius additionally

fundamentally deferred the beginning of DMBA/Croton oil actuated skin papilloma in mice. Carcinogenesis includes for the most part three stages initiation, promotion and progression. The implication of free radicals in various steps of carcinogenesis is all around reported [19, 20]. In our prior examinations they found that alcoholic concentrate of A. ilicifolius have cancer prevention agent and hepatoprotective impact [21]. Taking everything into account, the present investigation reveals that *A. ilicifolius* contain antitumor compounds [22].

## 3.6 Antioxidant and Cytotoxic Activity:

The methanol extract of *A. ilicifolius* contains phenolic substances grouped as cancer prevention agent compounds [23]. The limit of antiradical proficiency of *A. ilicifolius* flowers can be as medium. The extract was not in unadulterated structure; be that as it may, it very well may be arranged as a decent and potential antioxidant agent. The LC50 of extracts or pure compounds on salt water shrimp or cell line under 100 µg/mL is ordered as a potential cytotoxic and dangerous substance [24]. The ethanol leaves extract of *A. ilicifolius* was seen as cytotoxic towards lung fibroblast (L-929) cells in 72 h MTT test and the focus required for half-cell passing was 18 µg/mL[25], in the interim the methanol extract of this plant was cytotoxic to Hela and κB cell line[26]. Wostmann and Liebezeit [27] detailed that this mangrove contained cancer prevention agent substances. The most noteworthy cancer prevention agent and cytotoxic activity were found on methanol extract. Methanol has been known progressively powerful to break up dynamic mixes in cells. Henceforth, it was simpler to infiltrate the cell film to extract the intracellular fixings from plant materials. Tiwari et al.[28] expressed that few dynamic mixes will be gotten if methanol utilized as dissolvable in the extraction strategy for example anthocyanins, saponins, tannins, flavones, and polyphenols. These mixes have known as free radical scavenger, responsive species quencher, hydrogen donor, cancer prevention agent chemicals activator, detoxification inducer, ordinary normal cell differentiation promoter and expansion cell inhibitor, and apoptosis inducer [29-33]. The cytotoxicity of methanol extract can be related to the antioxidant activity and synergism impact of multi-part in separate. Triterpenoid saponin demonstrated its cytotoxicity in HeLa cells through both mitochondrial brokenness and ER stress cell passing pathways, while saponin stifled tumor obtrusive and relocation by hindering MMP-2 and MMP-9 activation [34]. Imai et al. established that flavonoid adequately smothered the multiplication of a human colon carcinoma cell line, COLO 201, through apoptosis acceptance while phenolic indicated anticancer action on disease colon cell by capturing the cell cycle [35-37]. All in all, the methanol concentrate of *A. ilicifolius* flower is potential as antioxidant (cancer prevention agent) substances and cytotoxic compounds [38].

### 3.7 Anticarcinogen against Hydrocortisone-Induced Genotoxicity:

Ahmad Md. et al, Studied the anti-genotoxic effect of *A. ilicifolius* against hydrocortisone-induced genotoxicity. Results showed the Acanthus extract is highly effective in cancer prevention and quench free oxygen radicals [39].

### 3.8 Anti-Leishmanial Activity:

**The** in-vitro anti-Leishmanial activity against Leishmania donovani showed by 2-Benzoxazolinone (BOA) isolated from the leaves the LC50 for BOA was 40µg/ml and compared well with pentamidine [40].

### 3.9 Anti-Ulcer activity:

The anti-ulcer activity of methanolic concentrates checked in the two models, normal parameter decided was the ulcer. MEAI at portions of 100, 20 mg/kg body weight created noteworthy restraint of gastric lesions induced by pylorus ligation and ethanol- induced gastric ulcers. The extract indicated huge decrease in the gastric volume, free acidity, and ulcer index as compared to control. This recommends leaf methanolic extracts were found to have anti-ulcerogenic as well as ulcer healing properties, which may be because of against secretary activity [41].

## IV. CONCLUSION

*A. ilicifolius* plant shows numerous phytochemicals which are responsible for pharmacological, medicinal activities. Further studies on *A. ilicifolius* are recommended to explore concealed areas to support clinical applications for betterment of health and to cover benefits of a mangrove plant.

**References:**

1. Wostmann, R. and G. Liebezeit, 2008. Chemical composition of the mangrove holly *Acanthus ilicifolius* (Acanthaceae) - review and additional data. Senckenbergiana Maritime, 38: 31-37.

2. Liu, L., H. Fan, P. Qi, Y. Mei, L. Zhou, L. Cai, X. Lin and J. Lin, 2013. Synthesis and hepatoprotective properties of *Acanthus ilicifolius* alkaloid A and its derivatives. Exp. Ther. Med., 6: 796-802.

3. Bandaranayake, W.M., 1998. Traditional and medicinal uses of mangroves. *Mangroves and Salt Marshes*, 2: 133-148.1998. doi.org/10.1023/A:1009988607044.

4. Simlai, A. And A. Roy, 2013. Biological activities and chemical constituents of some mangrove species from Sundarban estuary: An overview. Pharmacogn Rev., 7: 170-178.

5. Wang, Y., H. Zhu and N.F.Y. Tam, 2014. Polyphenols, tannins and antioxidant activities of eight true mangrove plant species in South China. Plant Soil, 549-563.

6. Singh D, Aeri V. Phytochemical and pharmacological potential of *Acanthus ilicifolius*. J Pharm Bioall Sci 2013; 5:17-20.

7. K T Mani Senthil Kumar et al., 2008. Anti-inflammatory activity of Acanthus ilicifolius , Journal of Ethnopharmacology, Vol 120, Issue 1, 30 October 2008, Pages 7-12 /doi:10.1016/j.jep.2008.07.024

8. SBose S, Bose A, 2008. Antimicrobial activity of Acanthus ilicifolius (L.) Indian J Pharm Sci; 70:821-3 / DOI: 10.4103/0250-474X.49134.

9. S Ganesh, and J Janet Vennila, 2010. Screening for Antimicrobial Activity in Acanthus ilicifolius Archives of Applied Science Research, , 2 (5):311-315.

10. Barry AL. 1976. The antimicrobial susceptibility test principle and practices. London: ELBS; p. 180.

11. G.Venkataiah, Mohammed Ishtiaq Ahmed, D. Sudharshan Reddy, Mary Rejeena. 2013. Anti-Diabetic Activity Of Acanthus Ilicifolius Root Extract In Alloxan Induced Diabetic Rats, Iajpr. 3(11):9007.

12. Kodama, H. A., Suda, Y., Kasai, H., and Yamamoto, S., 1981. Establishment of a clonal osteogenic cell line from newborn mouse calvaria. Jpn. J. Oral Biol., 23, 899–901.

13. Papoutsi, Z., Kassi, E., Mitakou, S., Aligiannis, N., Tsiapara, A., Chrousos, G., and Moutsatsou, P., 2006. Acteoside and martynoside exhibit estrogenic/antiestrogenic properties. J. Steroid Biochem. Mol. Biol., 98, 63-71.

14. Phan Van Kiem et al 2008. Chemical constituents of Acanthus ilicifolius L. and effect on osteoblastic MC3T3E1 cells Archives Of Pharmacal Research 31(7), 823-82. DOI 10.1007/s12272-001-1232-3.

15. Jiau-Jian, L., Larry, W.O., 1977. Over expression of manganese-con taining superoxide dismutase confers resistance to the cytotoxicity of tumour necrosis factor and/or hyperthermia. Cancer Research 57, 1991–1998.

16. Ruby, A.J., Kuttan, G., Babu, K.D., Rajasekharan, K.N., Kuttan, R., 1995. Antitumour and antioxidant activity of natural curcuminoids. Cancer Letters 94, 783.

17. Ming, L., Jill, C.P., Jingfang, Jn., Edward, C., Brash, E., 1998. Antioxidant action via p53 mediated apoptosis. Cancer Research 58, 1723–1729.

18. Putul, M., Sunit, C., Pritha, B., 2000. Neovascularisation offers a new perspective to glutamine related therapy. Indian Journal of Experimental Biology 38, 88–90.

19. Player, T., 1982. In: Mc Brein, D.C.H., Slater, T.F. (Eds.), Free Radicals and Cancer. Academic Press, London, pp. 173–195

20. Frenkel, K., 1992. Carcinogen mediated oxidant formation and oxidative DNA damage. Pharmacology Therapy 53, 127–166.

21. Babu, B.H., Shylesh, B.S., Padikkala, J., 2001. Antioxidant and hepatoprotective effect of Acanthus ilicifolius. Fittoterapia 72 (3), 271–276.

22. B H Babu et al 2002. Tumour reducing and anticarcinogenic activity of Acanthus ilicifolius in mice, doi:10.1016/S0378-8741(01)00347-6, Journal of Ethnopharmacology Vol 79, Issue 1, Pages 27-33.

23. Spavieri J, Allmendinger A, Kaiser M, Casey R, HingleyWilson S, Lalvani A, et al. 2010. Antimycobacterial, antiprotozoal, and cytotoxic potential of twenty-one brown algae (Phaeophyceae) from British and Irish waters. Phytother Res; 24: 1724-1729.

24. Ara J, Sultana V, Ehteshamul-Haque S, Qasim R, Uddin V. 1999. Cytotoxic activity of marine macro-algae on Artemia salina (Brine shrimp). Phytother Res; 13: 304-307.

25. Babu BH, Shylesh BS, Padikkala J. 2002. Tumour reducing and anticarcinogenic activity of Acanthus ilicifolius in mice. J Ethnopharmacol; 79: 27-33.

26. Khajure PV, Rathod JL. 2011. Potential anticancer activity of Acanthus ilicifolius extracted from the mangroves forest of Karwar, West Coast of India. World J Technol; 1: 1-6.

27. Wostmann R, Liebezeit G. 2008. Chemical composition of the mangrove holly Acanthus ilicifolius (Acanthaceae). Senckenbergiana; 38: 31-37.

28. Tiwari P, Kumar B, Kaur M, Kaur G, Kaur H. 2011. Phytochemical screening and extraction. Int Pharm Sci; 1: 98-106.

29. Breton F, Cérantola S, Gall EA. 2011. Distribution and radical scavenging activity of phenols in Ascophyllum nodosum (Phaeophyceae). J Exp Mar Biol Ecol; 399: 167–172.

30. Nielsen MF, Ingold KU. 2006. Kinetic solvent effects on proton and hydrogen atom transfers from phenols. Similarities and differences. J Am Chem Soc; 128: 1172-1182.

31. Fernandez-Pachon MS, Berna G, Otaolaurruchi E, Troncoso AM, Martin F, Garcia-Parrilla MC. 2009. Changes in antioxidant endogenous enzymes (activity and gene expression levels) after repeated red wine intake. J Agric Food Chem; 57: 65780– 65783.

32. Hsu YW, Tsai CF, Chen WK, Huang CF, Yen CC. 2011. A sub-acute toxicity evaluation of green tea (Camellia sinensis) extract in mice. Food Chem Toxicol; 49: 2624-2630.

33. Chahar MK, Sharma N, Dobhal MP, Joshi Y. 2011. Flavonoids: A versatile source of anticancer drugs. Pharmacog Rev; 5: 1-12 29.

34. Man S, Gao W, Zhang Y, Huang L, Liu C. 2010. Chemical study and medical application of saponins as anti-cancer agents. Fitoterapia; 81: 703-714.

35. Imai M, Kikuchi H, Denda T, Ohyama K, Hirobe C, Toyoda H. 2009. Cytotoxic effects of flavonoids against a human colon cancer derived cell line, COLO 201: A potential natural anti-cancer substance. Cancer Lett; 276: 74-80.

36. Gonzalez-Sarrias A, Li L, Seeram NP. 2011. Anticancer effects of maple syrup phenolics and extracts on proliferation, apoptosis, and cell cycle arrest of human colon cells. J Funct Foods; doi:10.1016/j.jff.2011.10.004.

37. Gonzalez-Sarrı´as A, Espın JC, Tomas-Barberan FA, GarcıaConesa MT. 2009. Gene expression, cell cycle arrest, and MAPK signalling regulation in Caco-2 cells exposed to ellagic and its metabolites, urolithins. Mol Nutr Food Res; 53: 686–698.

38. Muhamad Firdaus, Asep Awaludin Prihanto, Rahmi Nurdani 2013. Antioxidant and Cytotoxic Activity of Acanthus ilicifolius Flower, Asian Pac J Trop Biom ed. Jan; 3(1): 17–21. doi: 10.1016/S2221-1691(13)60017-9.

39. Ahmad Md. Sultan, Sheeba, Rai Kanchan B., Ali Afsar, 2012. Acanthus ilicifolius a Potent Anticarcinogen against Hydrocortisone-Induced Genotoxicity Study in Human Peripheral Lymphocytes Cultures, Advances in Life Sciences, Volume 1, Issue 1.

40. Kapil A, Sharma S, Wahidulla S. 1994. Leishmanicidal activity of 2-benzoxazolinone from Acanthus ilicifolius in vitro. Planta Med; 60:187-8.

41. Nizamuddin BS, Danamma B, Chitta S, Mohd D, Abdul M. 2011. Evaluation of antiulcer activity in the methanol extract of Acanthus ilicifolius leaves in experimental rats. Int J Pharm Ind Res; 1:57-62.