

Valladão GM, Gallani SU, Ikefuti CV, da Cruz C, Levy-Pereira N, Rodrigues MV, Pilarski F. [Essential oils to control ichthyophthiriasis in pacu, \*Piaractus mesopotamicus\* \(Holmberg\): special emphasis on treatment with \*Melaleuca alternifolia\*](#). J Fish Dis. 2016 Jan 18

In vitro effect of the *Melaleuca alternifolia*, *Lavandula angustifolia* and *Mentha piperita* essential oils (EOs) against *Ichthyophthirius multifiliis* and in vivo effect of *M. alternifolia* for treating ichthyophthiriasis in one of the most important South American fish, *Piaractus mesopotamicus* (Holmberg), were evaluated. The in vitro test consisted of three EOs, the results demonstrated that all tested EOs showed a cytotoxic effect against *I. multifiliis* compared to control groups ( $P < 0.05$ ). The in vivo treatment for white spot disease was performed in a bath for 2 h day<sup>-1</sup> for 5 days using the *M. alternifolia* EO (50  $\mu\text{L L}^{-1}$ ). In this study, 53.33% of the fish severely infected by *I. multifiliis* survived after the treatment with *M. alternifolia* (50  $\mu\text{L L}^{-1}$ ) and the parasitological analysis has shown an efficacy of nearly 100% in the skin and gills, while all the fish in the control group died. Furthermore, the potential positive effect of *M. alternifolia* EO against two emergent opportunistic bacteria in South America *Edwardsiella tarda* and *Citrobacter freundii* was discussed.

M Dos Santos W, S de Brito T, de A Prado S, G de Oliveira C, C De Paula A, C de Melo D, A P Ribeiro P. [Cinnamon \(\*Cinnamomum\* sp.\) inclusion in diets for Nile tilapia submitted to acute hypoxic stress](#). Fish Shellfish Immunol. 2016 Jul;54:551-5.

The aim of this study was to evaluate the possible effects of diets supplemented with probiotics and different cinnamon levels (powder and essential oil) on immunological parameters of Nile tilapia after being subjected to acute stress by hypoxia. Three hundred and thirty juvenile male tilapia fish ( $66.08 \pm 2.79$  g) were distributed in 30 tanks of 100 L capacity (11/cage) with a water recirculation system. The animals were fed for 71 days with diets containing extruded cinnamon powder at different levels (0.5, 1, 1.5, 2%), cinnamon essential oil (0.05, 0.1, 0.15; 0.2%) and probiotics (0.4%), all in triplicate. At the end of the experiment, the fish ( $200.36 \pm 19.88$  g) of the different groups were subjected to stress by hypoxia. Hypoxia was achieved by capturing the animals with a net, keeping them out of the water for three minutes, and then sampling the blood 30 min after the procedure to determine the levels of cortisol, glucose, haematocrit, lysozyme, bactericidal index, total protein, and its fractions. The animals kept blood homeostasis after hypoxic stress. Diet supplementation with 0.5% cinnamon powder improved the fish immune response, since it resulted in an increase of 0.5% in  $\gamma$ -globulin level. Administration of 0.15% cinnamon essential oil resulted in an increase of  $\alpha_1$  and  $\alpha_2$ -globulins, which may be reflected in increased lipid content

of the carcass and the hepatosomatic index. More studies are necessary to better understand the effects of these additives for fish immunity.

Ghehdarijani MS, Hajimoradloo A, Ghorbani R, Roohi Z. [The effects of garlic-supplemented diets on skin mucosal immune responses, stress resistance and growth performance of the Caspian roach \(\*Rutilus rutilus\*\) fry.](#) Fish Shellfish Immunol. 2016 Feb;49:79-83.

This study was conducted to evaluate the effects of garlic supplementation on some skin mucus immune parameters, mucus antimicrobial activity and growth performance of the Caspian roach (*Rutilus rutilus caspicus*) fry. Fish ( $1 \pm 0.07$  g) were divided into four groups fed diets containing 0 (control), 5, 10 and 15 g kg<sup>-1</sup> garlic for 8 weeks. The results showed that there was a significant increase in weight gain and specific growth rate in those fish fed garlic diets compared with the control ( $P < 0.05$ ). Condition factor was not significantly affected by garlic dosage. At the end of trial, the epidermal mucus protein level, alkaline phosphatase and antimicrobial activity against 2 g-negative bacteria (*Escherichia coli* and *Serratia marcescens*) and gram-positive bacteria (*Streptococcus faecium* and *Micrococcus luteus*) were measured. Skin mucus alkaline phosphatase, protein levels and antimicrobial activity were increased following garlic administration, and the bacterial growth inhibition zones were significantly elevated in garlic-fed fish ( $P < 0.05$ ). In salinity stress experiment, no differences were observed for survival rate among the experimental diets. No mortality was recorded during the feeding trial. These results indicated that dietary garlic beneficially affects the skin mucus immune parameters and growth performance of the Caspian roach fry.

Kareem ZH, Abdelhadi YM, Christianus A, Karim M, Romano N [Effects of some dietary crude plant extracts on the growth and gonadal maturity of Nile tilapia \(\*Oreochromis niloticus\*\) and their resistance to \*Streptococcus agalactiae\* infection.](#) Fish Physiol Biochem. 2016 Apr;42(2):757-69.

A 90-day feeding trial was conducted on the growth performance, feeding efficacy, body indices, various hematological and plasma biochemical parameters, and histopathological examination of the gonads from male and female Nile tilapia fingerlings when fed different crude plant extracts from *Cinnamomum camphora*, *Euphorbia hirta*, *Azadirachta indica*, or *Carica papaya* at 2 g kg<sup>-1</sup> compared to a control diet. This was followed by a 14-day challenge to *Streptococcus agalactiae*. All treatments were triplicated, and each treatment consisted of 30 fish. Results showed

that *C. papaya* extracts were the most effective at delaying gonadal maturation to both male and female tilapia, as well as significantly increasing ( $P < 0.05$ ) growth performance compared to the control treatment. Similarly, dietary *C. camphora* and *E. hirta* extracts also significantly improved growth, while no significant growth effect was detected between the *A. indica* and control treatments ( $P > 0.05$ ). Further, crude body lipid was lower in the *C. camphora*, *E. hirta* and *C. papaya* treatments, but was only significantly lower for the *E. hirta* treatment compared to the control. Meanwhile, none of the hematological or biochemical parameters were significantly affected, although plasma ALT was significantly lower for tilapia fed *A. indica* compared to the control. After the 14-day bacterial challenge, tilapia fed *C. camphora* supplementation had significantly higher survival, compared to the control, but was not significantly higher than the other supplemented diets. Results indicate that dietary *C. papaya* extract can significantly promote growth and delay gonadal maturation to both male and female tilapia, while *C. camphora* was the most effective prophylactic to *S. agalactiae* and may be a cost-effective and eco-friendly alternative to antibiotics.

Kirubakaran CJ, Subramani PA, Michael RD. [Methanol extract of \*Nyctanthes arbortristis\* seeds enhances non-specific immune responses and protects \*Oreochromis mossambicus\* \(Peters\) against \*Aeromonas hydrophila\* infection.](#) Res Vet Sci. 2016 Apr;105:243-8.

Immunostimulation using medicinal plant extracts is a promising approach for prevention and control of diseases with reference to sustainable fish farming. *Oreochromis mossambicus*, dubbed as aquatic chicken is a cultured fish worldwide and a laboratory model organism. *Aeromonas hydrophila* is one of the major bacterial pathogens in fish farming that causes huge loss to aquaculture industries. In this study, we investigated the efficacy of methanol extract of *Nyctanthes arbortristis* seeds on disease resistance of *O. mossambicus* against live virulent *A. hydrophila*. We also investigated its effect on the non-specific immune parameters such as serum lysozyme, myeloperoxidase, antiprotease and specific immune parameters in terms of specific serum antibody titres assayed by bacterial agglutination test. Our studies indicate that intra-peritoneal administration of 20mg/kg methanol extract increases the Relative Percent Survival (RPS) of *O. mossambicus* challenged with LD80 of *A. hydrophila*. Further, both non-specific and specific immune parameters were enhanced by the methanol extract. Further experiments at molecular levels in the laboratory and also efficacy testing at field level are essential before applying this plant product in aquaculture industry.

Fridman S, Sinai T, Zilberg D. [Efficacy of garlic based treatments against monogenean parasites infecting the guppy \(\*Poecilia reticulata\* \(Peters\)\)](#). *Vet Parasitol.* 2014 Jun 16;203(1-2):51-8.

Monogenean infections of commercially farmed fishes are responsible for significant economic losses. Garlic (*Allium sativum*) is a well-known spice which also possesses anti-microbial and anti-parasitological properties. The current work aimed to test the efficacy of garlic-based treatments against infection with monogenean sp. in the guppy (*Poecilia reticulata*). Clipped sections of tail fins of guppies heavily infected with *Gyrodactylus turnbulli* were exposed to aqueous garlic extract (7.5 to 30 mL L<sup>-1</sup>) and visually observed under a dissecting microscope. Results revealed that exposure to garlic caused detachment of parasite and cessation of movement indicating death. A positive correlation was seen between garlic concentration and time to detachment and death of parasites, which, at the highest concentration of 30 mL L<sup>-1</sup>, occurred at 4.1 and 8.6 min, respectively. Bathing in aqueous garlic extract (7.5 and 12.5 mL L<sup>-1</sup>) was tested in guppies infected with *G. turnbulli*. Prior acute toxicity tests revealed the maximum tolerance levels of guppies to garlic extract to be 12.5 mL L<sup>-1</sup> for 1h. Bathing of infected fish in garlic extract (7.5 and 12.5 mL L<sup>-1</sup>) significantly ( $p < 0.05$ ) reduced infection prevalence and intensity as compared to the control. Oral treatments using dry garlic powder-supplemented diet were tested on guppies infected with *G. turnbulli* and *Dactylogyrus* sp. Fish were fed with food containing 10% and 20% dry garlic powder for 14 days. Groups fed with garlic supplemented diets showed significantly reduced ( $p < 0.05$ ) mean prevalence and mean intensity of parasites as compared to the control. Dietary application of garlic did not appear to affect palatability. Fresh crushed garlic was added at a level of 1 g L<sup>-1</sup> and applied as an indefinite bath for 14 days. This treatment was seen to significantly reduce ( $p < 0.05$ ) parasite prevalence and mean intensity as compared to the control. Histopathology revealed elevated muscular dystrophy in the 20% garlic-fed group, as compared to control. These findings demonstrate the potential of garlic as a natural alternative to currently used chemical treatments for monogenean sp. infection in the guppy.

Schelkle B, Snellgrove D, Cable J. [In vitro and in vivo efficacy of garlic compounds against \*Gyrodactylus turnbulli\* infecting the guppy \(\*Poecilia reticulata\*\)](#). *Vet Parasitol.* 2013 Nov 15;198(1-2):96-101

Traditional compounds used to treat fish diseases in aquaculture and the ornamental fish industry (such as formalin and malachite green) can be more toxic to the hosts than their parasites. With the resurgence in the use of herbal products, various botanicals have been heralded as cures for particular pathogens, but the efficacy of

these compounds for parasitic worms is questionable. Here, we tested a range of garlic (*Allium sativum*) products against a major aquarium pathogen, *Gyrodactylus turnbulli*, infecting the guppy (*Poecilia reticulata*). All garlic products significantly reduced parasite mean survival time in vitro, from 13 h to <1 h. In fully randomised trials, the number of parasites was also significantly reduced on infected fish exposed to garlic from different sources. Two garlic treatments (minced and granule forms) reduced worm burdens by 66% and 75% after three doses, whereas Chinese freeze-dried garlic and allyl disulphide were 95% effective after a single application. In fact, Chinese freeze dried garlic was equally effective as Levamisole, a licensed livestock dewormer that is highly effective against *G. turnbulli* but not routinely prescribed for use in fish; hence, garlic may be a potential alternative treatment for gyrodactylosis.

Militz TA, Southgate PC, Carton AG, Hutson KS. [Efficacy of garlic \(\*Allium sativum\*\) extract applied as a therapeutic immersion treatment for \*Neobenedenia\* sp. management in aquaculture.](#) J Fish Dis. 2014 May;37(5):451-61

Garlic, *Allium sativum* L., extract administered as a therapeutic bath was shown to have antiparasitic properties towards *Neobenedenia* sp. (MacCallum) (Platyhelminthes: Monogenea) infecting farmed barramundi, *Lates calcarifer* (Bloch). The effect of garlic extract (active component allicin) immersion on *Neobenedenia* sp. egg development, hatching success, oncomiracidia (larvae) longevity, infection success and juvenile *Neobenedenia* survival was examined and compared with freshwater and formalin immersion. Garlic extract was found to significantly impede hatching success ( $5\% \pm 5\%$ ) and oncomiracidia longevity (<2 h) at allicin concentrations of  $15.2 \mu\text{L L}^{-1}$ , while eggs in the seawater control had >95% hatching success and mean oncomiracidia longevity of  $37 \pm 3$  h. At much lower allicin concentrations ( $0.76$  and  $1.52 \mu\text{L L}^{-1}$ ), garlic extract also significantly reduced *Neobenedenia* infection success of *L. calcarifer* to  $25\% \pm 4\%$  and  $11\% \pm 4\%$ , respectively, compared with  $55\% \pm 7\%$  in the seawater control. Juvenile *Neobenedenia* attached to host fish proved to be highly resistant to allicin with 96% surviving 1-h immersion in  $10 \text{ mL L}^{-1}$  ( $15.2 \mu\text{L L}^{-1}$ ) allicin) of garlic extract. Allicin-containing garlic extracts show potential for development as a therapy to manage monogenean infections in intensive aquaculture with the greatest impact at the egg and larval stages.

Abd El-Galil MA, Aboelhadid SM. [Trials for the control of trichodinosis and gyrodactylosis in hatchery reared \*Oreochromis niloticus\* fries by using garlic.](#) Vet Parasitol. 2012 Apr 30;185(2-4):57-63.

The present work was designed to study the prevalence of trichodinosis and gyrodactylosis in *Oreochromis niloticus* fries, and to test the therapeutic efficacy and preventive efficacy of garlic oil and crushed garlic cloves. Trichodinosis and gyrodactylosis are ectoparasitic diseases that affect most warm freshwater fish, especially fries and fingerlings. In a private *O. niloticus* fish hatchery, the prevalence of trichodinosis in 5-, 15- and 30-day-old-fries was 37%, 23% and 40.5%, respectively. The highest infection intensity was detected in 30-day-old-fries. The gyrodactylosis was reported only in combination with trichodinosis. In addition, we found that its prevalence in 5-, 15- and 30-day-old-fries was 17%, 19.5% and 29%, respectively. Mortality rate of fry in the first month of life was 53% as a result of injury to these two types of parasites. The garlic oil and crushed garlic cloves were tested in both in vitro and earthen ponds of the hatchery. Using 2-, 2.5- and 3-ppt (parts per thousand) garlic oil for 4h in vitro water bath treatment resulted in 100% recovery, while 1 and 1.5 ppt garlic oil, respectively, needed 24 and 16 h to treat the infected fries. The treatment by 3 ppt garlic oil as a water bath for 1h treated the two diseases in 55% in 7 days from application in the hatchery earthen pond. In the mean time, 300 mg L<sup>-1</sup> crushed garlic cloves as an indefinite bath in the hatchery earthen pond eliminated 68% of the diseases. The same protocol for preventing the two diseases resulted in obtaining 65% and 75% of parasite free fries, for garlic oil and crushed garlic cloves, respectively, compared to 53% of the control fries.

Levy G, Zilberg D, Paladini G, Fridman S. [Efficacy of ginger-based treatments against infection with \*Gyrodactylus turnbulli\* in the guppy \(\*Poecilia reticulata\* \(Peters\)\).](#) Vet Parasitol. 2015 Apr 30;209(3-4):235-41.

Monogenean infections of commercially farmed fishes are responsible for significant economic losses and existing chemical therapeutants, often stressful to the fish, pose associated risks. As part of a recent trend to move towards the use of alternative, plant-based remedies for commonly occurring aquaculture-related diseases, the efficiency of ginger (*Zingiber officinale*) was investigated against the monogenean parasite *Gyrodactylus turnbulli* in the guppy. In vitro trials revealed the clear anti-parasitic effects of ginger. Ethanolic and aqueous extracts, prepared from freeze dried ginger, were tested. An increase in extract concentration was associated with reduced time to parasite immobilisation, with ethanolic extract being more efficient; at 75 and 200ppt aqueous ginger extract parasites died at  $65.6 \pm 2.8$  and  $1.8 \pm 0.2$ min, respectively, whereas at 5 and 40ppt ethanolic extract parasites died at  $26.1 \pm 0.7$  and  $4.9 \pm 0.3$ min, respectively. Bathing *G. turnbulli*-infected fish in ethanolic ginger extract (i.e. 5 and 7.5ppt for 90 and 30min, respectively) significantly reduced infection prevalence and intensity when compared to the water and ethanol controls. The higher concentration (i.e. 7.5ppt) proved as equally effective as Praziquantel, the conventionally used chemical treatment for gyrodactylosis, with the fish appearing to be completely cleared of the infection in both cases. Oral treatments of *G. turnbulli*-

infected guppies with diets supplemented with 10 and 20% ginger powder proved to be ineffective in decreasing parasite load. These findings demonstrate that immersion in ginger extract offers an effective, alternative treatment against monogenean infection in fish.

Gabriel NN, Qiang J, He J, Ma XY, Kpundeh MD, Xu P. [Dietary Aloe vera supplementation on growth performance, some haemato-biochemical parameters and disease resistance against Streptococcus iniae in tilapia \(GIFT\)](#). Fish Shellfish Immunol. 2015 Jun;44(2):504-14.

This study investigated effects of dietary Aloe vera on growth performance, some haemato-biochemical parameters and disease resistance against Streptococcus iniae in tilapia (GIFT). Five groups were designed including a basal diet (control) and 100% A. vera powder incorporated in fish feed at 0.5% 1%, 2%, and 4%/kg feed, which were administered for 8 weeks. Fish fed 0.5%, 1%, and 2% A. vera supplemented diet significantly improved ( $p < 0.05$ ) weight gain, absolute growth rate and specific growth rate. Feed intake significantly increased in fish fed with A. vera diet at 1% and 2%/kg feed. Feed efficiency ratio, feed conversion ratio, and hepatosomatic index were significantly enhanced in 4% A. vera supplemented fish over unsupplemented ones ( $p < 0.05$ ). Several haemato-biochemical indices were examined before and after fish were challenged with S. iniae pathogen containing  $7.7 \times 10^6$  CFU cells mL<sup>-1</sup>. A. vera supplemented fish showed a significant increase ( $p < 0.05$ ) in red blood cells, hematocrits (Hb), hemoglobin (Hb), white blood cells (WBC), neutrophils, monocytes, eosinophils, serum total protein, glucose and cortisol after challenge when compared to unsupplemented ones. Meanwhile, 4% A. vera supplemented fish showed a decrease ( $p < 0.05$ ) in RBC, Hb, Ht, WBC, and mean corpuscular hemoglobin (MCH) after challenge compared to unsupplemented ones and other supplemented ones. In addition, lower mean corpuscular volume values (MCV) ( $p < 0.05$ ) were observed in fish fed with A. vera diet at 2% and 4% A. vera/kg feed than those fed unsupplemented diet. Unchallenged fish fed 0.5%, 1%, and 2% A. vera showed significantly higher values ( $p < 0.05$ ) of mean corpuscular hemoglobin concentration (MCHC) than those fed unsupplemented diet and 4% A. vera supplemented diet. There was a significant increase ( $p < 0.05$ ) in the neutrophil to lymphocyte ratio (N/L) within experimental groups after challenge; N/L ratio in A. vera unsupplemented fish and those supplemented with A. vera diet at 1%/kg feed increased significantly ( $p < 0.05$ ) throughout challenge period; while those fed 4% A. vera supplemented diet maintained higher values at all experimental stages among groups. There was a significant correlation ( $p < 0.05$ ,  $r = 0.53$ ) between N/L ratio and glucose concentration, 96 h after challenge. Aloe had no significant effect ( $p > 0.05$ ) on the survival of the fish when compared to the control; no mortality was recorded in challenge trial. Overall, our results indicated that dietary aloe supplementation could

improve growth, feed utilization, and haemato-biochemical parameters of cultured tilapia.

Zhou J, Li C, Wang L, Ji H, Zhu T. [Hepatoprotective effects of a Chinese herbal formulation, Yingchen decoction, on olaquinox-induced hepatopancreas injury in Jian carp \(\*Cyprinus carpio\* var. Jian\)](#). *Fish Physiol Biochem*. 2015 Feb;41(1):153-63.

In order to identify effective hepatoprotective herbs for clinical application in fish farming, 200 mg/kg olaquinox (OLA) was added to a basal diet (group 1, control) to form OLA diet (group 2), then 1.35, 2.7 and 5.4 % (w/w) of a Chinese herbal formulation, Yingchen decoction (YCD), were added to the OLA diet to form three additional diets for groups 3, 4 and 5, respectively. A total of 375 juvenile Jian carp (*Cyprinus carpio* var. Jian) ( $52.12 \pm 2.95$  g/tail) were divided into five groups (triplicates per group) and fed the five diets mentioned above, respectively, for 6 weeks. At the termination of feeding experiment, serum biochemical indexes, viability of hepatocytes and the hepatopancreas microstructure for each group were detected and observed. The results showed that serum ALT and AST in group 2 were significantly higher than the control ( $P < 0.05$ ). Plasma membranes hepatocyte nuclei in group 2 were found to be mostly indistinct, compared to group 1, and gradually recovered with the increasing supplementation of YCD in group 3, 4 and 5. The viability of isolated hepatocytes in group 2 was the lowest and gradually recovered with the increasing supplementation of YCD in group 3, 4 and 5. The results suggest that YCD protected the Jian carp hepatopancreas against injury from OLA, and that 5.4 % YCD would be the optimum dosage in a Jian carp diet.

Tang J, Cai J, Liu R, Wang J, Lu Y, Wu Z, Jian J. [Immunostimulatory effects of artificial feed supplemented with a Chinese herbal mixture on \*Oreochromis niloticus\* against \*Aeromonas hydrophila\*](#). *Fish Shellfish Immunol*. 2014 Aug;39(2):401-6.

The effects of a Chinese herbal mixture (CHM) composed of astragalus, angelica, hawthorn, Licorice root and honeysuckle on immune responses and disease resistant of Nile tilapia (*Oreochromis niloticus* GIFT strain) were investigated in present study. Fish were fed diets containing 0 (control), 0.5%, 1.0%, 1.5% or 2.0% CHM (w/w) for 4 weeks. And series of immune parameters including lysozyme, cytokine genes TNF- $\alpha$  and IL-1 $\beta$ , superoxide dismutase (SOD), peroxidase (POD), malondialdehyde (MDA) were measured during test period. After four weeks of feeding, fish were infected with *Aeromonas hydrophila* and mortalities were recorded. Results of this study showed that feeding Nile tilapia with CHM-supplementation diet stimulated lysozyme



activity, SOD activity and POD activity in serum, induced TNF- $\alpha$  and IL-1 $\beta$  mRNA expression in head kidney and spleen, but decreased serum MDA content. All CHM-supplemental groups showed reduced mortalities following *A. hydrophila* infection compared with the group fed the control diet. These results suggested that this CHM can be applied as a tilapia feed supplement to elevate fish immunity and disease resistance against *A. hydrophila*

Fu Y, Zhang Q, Xu DH, Xia H, Cai X, Wang B, Liang J. [Parasitocidal effects of Morus alba root bark extracts against Ichthyophthirius multifiliis infecting grass carp.](#) *Dis Aquat Organ.* 2014 Feb 19;108(2):129-36

*Ichthyophthirius multifiliis* (Ich), an important fish parasite, can cause significant losses in aquaculture. To find efficacious drugs to control Ich, the root bark of white mulberry *Morus alba* was evaluated for its antiprotozoal activity. Bark was powdered and extracted with 1 of 5 organic solvents: petroleum ether, chloroform, ethyl acetate, acetone, or methanol. The extracts were concentrated, dissolved in 0.1% (v/v) DMSO, and used for anti-Ich trials. Acetone and ethyl acetate extracts significantly reduced the survival of Ich tomonts and theronts. In vitro, acetone extract at 25 mg l<sup>-1</sup> killed all non-encysted tomonts, at 50 mg l<sup>-1</sup> eradicated all encysted tomonts, and at 8 mg l<sup>-1</sup> caused mortality of all theronts. Ethyl acetate extract at 50 mg l<sup>-1</sup> eliminated all non-encysted tomonts, at 100 mg l<sup>-1</sup> killed all encysted tomonts and terminated tomont reproduction, and at 8 mg l<sup>-1</sup> killed all theronts. Low concentrations (2 and 4 mg l<sup>-1</sup>) of acetone and ethyl acetate extracts could not kill all theronts after 4 h exposure, but a significant decrease in theront infectivity was observed following 30 min of pretreatment with the extracts. The 96 h LC(50) values of acetone and ethyl acetate extracts to grass carp were 79.46 and 361.05 mg l<sup>-1</sup>, i.e. much higher than effective doses for killing Ich theronts (8 mg l<sup>-1</sup> for both extracts) and non-encysted tomonts (12.5 and 25 mg l<sup>-1</sup>, respectively). Thus *M. alba* extract may be a potential new, safe, and efficacious drug to control Ich

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