Effect of probiotic acidophilus plus against infection with secondary hydatid disease in BALB/c mice

S.Y. Yousif¹ and A.A. Ali²

Department of Biology, College of Education for Pure Sciences, University of Mosul, Mosul, Iraq

Email: ¹massd2313@gmail.com, ²assssali@uomosul.edu.iq

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Abstract

The current study investigated the effect of acidophilus plus probiotic in the immune activities in mice to infestation with the cystic echinococcosis. Two dilutions of the probiotic bacteria $9 \times 10^6/0.1$ ml, $30 \times 10^3/0.1$ ml CFU were used, by intraperitoneally injection in the experimental animals, pre and post infections with protoscoleces of *Echinococcus granulosus*. Before infection remedy comprised injection by acidophilus plus twice with 72 hours interval, on the seventh day, animals were injected with protoscoleces intraperitoneally, after infection remedy implicated injection of animals with protoscoleces of *Echinococcus* protoscoleces first, next to 72 hours, probiotics were inoculated intraperitoneally. Many criteria were taken into consideration including, numbers, weights, diameters and percentage reduction of hydatid cysts of treated mice in contrast to the animals infested with only. The study showed a decline in cysts including their diameter, weighting, digit, accompanied by increasing the percentage reduction of hydatid cysts in treated mice, the highest percentage reduction was 98.03%, at both dilutions, 6 months post infection, and the minimum cysts number was 0.8 in comparison with the control group 39.4, with significant difference, in the same experiment. The minimum cysts weight was 0.0104 gm, 6 months post infection at the dilution $9 \times 10^6/0.1$ ml CFU, compared with the control group 0.442 gm. The smallest cysts diameter was 0.057 mm in comparison with the control group 0.882 mm at dilution $9 \times 10^6/0.1$ ml CFU, 6 months post infection. Acidophilus plus it may well be deduced that probiotic bacteria can be used as medicinal and remedial method against infection with hydatidosis.

Keywords: Probiotics, *Lactobacillus acidophilus*, *L. casei casei*, *L. casei rhamnosus*, Hydatid disease

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تأثير المعزز الحيوي acidophilus plus ضد الإصابة بداء الأكياس العددرية الثانوي في الفئران

سهيلة يعقوب يوسف و أسماء عبدالعزيز علي

فرع علوم الحياة، كلية التربية للعلوم الصفرية، جامعة الموصل، الموصل، العراق

الخلاصة

تحترم الدراسة الحالية عن تأثير المعزز الحيوي acidophilus plus في الفعاليات المناعية للفئران تجاه الإصابة بداء المشوكات الكيسي. استخدم تخفيفين من البكتريا $3 \times 10^1/0.1$ ml و $3 \times 10^2/0.1$ ml CFU و $9 \times 10^6/0.1$ ml CFU و $3 \times 10^3/0.1$ ml CFU، بواسطة الحقن داخل البريتوني في حيوانات التربة، قبل الإصابة و بعدها بالروسيات الأولية لدودة المشوكات الحبيبية. تضمنت المعالمة قبل الإصابة حقن المعزز الحيوي مرتين، بفترة فاصلة ٢٧ ساعة، وفي اليوم السابع، حقنت الحيوانات بالروسيات الأولية داخل البريتون. تضمنت المعالجة بعد الإصابة حقن الحيوانات بالروسيات الأولية للرشكة الحبيبية أولاً، ثم حقنها بالمعزز الحيوي داخل البريتون بعد ٢٧ ساعة من الإصابة. أخذت معايير عدة بنظر الإعتبار من اتتاد أوزان أظهرت دراسة اختلافًا في أوزان أوزان، أظهرت الأمكاس العددرية، صاحبه زيادة في نسبة اختزال الأكياس في الفئران المعالمة. كانت أعلى نسبة اختزال ٩٨.٣% عند كلا التخفيفين بعد ٣ أشهر من الإصابة، وبلغ أقل عدد للأكياس ٠.٨ بالمقارنة مع مجموعة السيطرة ٣٩.٤٤ غم عند تخفيف
Introduction

Cystic echinococcosis is the larval cystic stage (called Echinococcal cysts) of a small taeniid-type tapeworm (Echinococcus granulosus) that may cause illness in intermediate hosts, generally herbivorous animals and people who are infected accidentally, it a zoonotic disease spreads worldwide, a common prevalent in stock raising areas, like Australia and Middle East region (1). It is neglected tropical areas disease, which is the most important reason of health deficiency and economic losses. China is account as a considerable part of the global loss (2). Cystic echinococcosis is causing by Echinococcus cestoda, the common species, E. granulosus. Humans are accidentally infected by ingesting the parasite eggs which are raised from specific hosts (e.g. wolves, dogs, foxes, and jackals) (3), by fecal-oral stream. Parasite ova ingested in the human digestive systems, hatched in duodenum, growing up as larvae and passing through the gut wall into liver with blood route. About 75% of cases affect liver (2,4,5). The taxonomy of genotypes/species, leading to cystic echinococcosis, includes the subdivided E. garnulosus senso lato complex groups, E. granulosus sensu stricto, E. equines, E. ortleppi, E. Canadensis, and E. felids (lion strain) (6,7). In medicine, it is difficulty for drugs to permeate into the multiple layers of the hydatid cyst, but chemotherapy and operation are still the most utilized methods for therapy of cystic Echinococcosis (8). Albendazole drug is ovicidal, larvicial and vermicidal, but operation is still the main treatment (3,9). So, researchers, in recent years, have developed new alternatives in an attempt for elimination of some parasitic infections. The most important is the use of probiotic bacteria, probiotics represent microbiota of different sources endogenous and exogenous, of which are most important for human and animals if administrated on adequate amount (10). The prophylactic activity of this type of bacteria may be by competition, exclusion and impedance to harmful bacteria of the intestine. Other technique involves synthesis of compounds against bacteria, includes H₂O₂, bacteriocin, and immunomodulation (11). Several studies proved the efficacy of probiotics for prevention against many diseases such as, cancer, allergies, inflammatory, intestinal and autoimmune disease (12). Probiotics effect on other eukaryotic pathogens, explained the efficacy of Lactobacillus in the prevention contra extra intestinal parasites, such as Plasmodium, Babesia (13). The effects of useful microorganisms, probiotics became interesting for their protection or therapeutic applications against diseases including worm diseases (14) like zoonotic Schistosomiasis which is caused by genus Schistosoma (15). Other probiotics strains such as L. acidophilus, L. plantarum and L. delbrueckii revealed an obvious activity versus ancylostomiasis in normally affected canine with a disease. Elevation of white blood cells has been observed (16). Researchers found that L. casei is the firstly strain among other strains of Lactobacilli has anthelmintic effect of about 75-100% prevention, another strain is L. plantarum with efficacy of 90% against Trichenilla spiralis (17).

The aim of the current study is to use probiotic bacteria, for the first time, against infection with secondary hydatid disease as an antiparasitic immunomodulator in BALB/c mice, depending on many criteria including numbers, weights, diameters, and percentage reduction of hydatid cysts in the experimental animals, in comparison with the control group.

Material and methods

Laboratory animals

One month-aged experimental animals (Swiss mice) were utilized.

Cysts samples

Ovine cysts containing protoscoleces were obtained under sterilized conditions, alive protoscoleces, 20 μl of protoscoleces suspension were added to 20 μl of 0.1% of eosin pigment on a slide, then tested under light microscope. Bright green protoscoleces were considered as alive because of eosin exclusion by protoscoleces membranes, whereas red protoscoleces were regarded as dead because of acceptance of the pigment gained and counted according to authenticated manner (18, 19,20).

Bacterial strains preparation and inoculation

One capsule of acidophilus plus provides lactobacilli culture, typically providing 2 billion of L. acidophilus, L. casei casei and L. casei rhamnosus. These lactobacilli strains were grown in nutrient broth medium for 24 hours then the culture was diluted in normal saline to contain 9*10⁶ /0.1 ml CFU of acidophilus plus probiotics, the second dilution in normal saline contains 30*10³ /0.1 ml CFU of acidophilus plus probiotics (16,20).
Experimental design

Animals were divided into seven groups, each group comprised of five animals. Group one: 30 Mice (5 mice for each experiment as control group) were injected with 2000 protoscoleces /20 gm body weight intraperitoneally by 0.1 ml of protoscoleces diluted in phosphate buffer saline (PBS). Group two: 5 Mice were injected intraperitoneally with the probiotic acidophilus plus 9*10^6/0.1 ml CFU, twice with interval 72 hours, on the 7th day mice were injected with 2000 protoscoleces. Injection with probiotics continued for 50 days. Mice were dissected 2 months post infection. Group three: 5 Mice were injected intraperitoneally with probiotic acidophilus plus 9*10^6/0.1 ml CFU, twice with interval 72 hours, on the 7th day mice were injected with 2000 protoscoleces. Injection with probiotics continued for 110 days. Mice were dissected 4 months post infection. Group four: 5 Mice were injected intraperitoneally with probiotic acidophilus plus 9*10^6/0.1 ml CFU, for 170 days with 72 hours intervals, on the 7th day mice were injected with 2000 protoscoleces intraperitoneally. Mice were dissected 6 months post infection. Group five: 5 Mice were injected intraperitoneally with 2000 protoscoleces, after 3 days the mice were injected intraperitoneally with acidophilus plus 30*10^3/0.1 ml CFU for 50 days, with 72 hours intervals, mice were dissected after 2 months. Group six: 5 Mice were injected intraperitoneally with 2000 protoscoleces, after 3 days mice were injected intraretinally with acidophilus plus 30*10^3/0.1 ml CFU for 110 days with 72 hours intervals, mice were dissected after 4 months. Group seven: 5 Mice were injected intraperitoneally with 2000 protoscoleces, after three days mice were injected with acidophilus plus 30*10^3/0.1 ml CFU for 170 days with 72 hours intervals, mice were dissected after 6 months.

Statistical analysis

For testing the variances between the periods and dilution of bacteria acidophilus plus, a Complete Randomized Design (CRD) was performed. Then, the variances between groups mean values were tested by Duncan's multiple range test. The test periods, as a quantitatively value, were compared by the Analysis of Variance (ANOVA). Two ready packages, Statistical Analysis System (SAS) and Minitab were applied (21).

Results

Cysts weights declined obviously in groups cured with acidophilus plus, reached the minimum 0.0104 gm at the dilution 9*10^6/0.1 ml (CFU) after 6 months of infestation, opposed infected animals with the parasite only 0.442 gm (Table 1, Table 5).
Figure 2: Mouse infected with protoscoleces treated by acidohilus plus 30*10³/0.1 ml (CFU) 4 months postinfection.

Figure 3: Mouse infected with protoscoleces treated by acidohilus plus 9*10⁶/0.1 ml (CFU)- 4 months post infection.

Cysts diameters diminished clearly in all handled animals by acidophilus plus, reached the minimum 0.057 mm at the dilution 9*10⁶/0.1 ml (CFU) after 6 months of invasion compared to uncured association 0.882mm (Table 3, Table 5, Figures 4 and 5).

Table 3: Effect of acidophilus plus 9*10⁶/0.1 ml and 30*10³/0.1 ml (CFU) on means of cystic larvae diameters of treated animals occupied by protoscoleces rapprochement to the versus groups during 2, 4, 6 months

<table>
<thead>
<tr>
<th>Dilution of bacteria</th>
<th>Months</th>
<th>Means of bacterial treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Two</td>
<td>Four</td>
</tr>
<tr>
<td>10⁶</td>
<td>0.375&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>0.106&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>10³</td>
<td>0.089&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>0.131&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>Control</td>
<td>0.497&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.500&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Mean Periods</td>
<td>0.320&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>0.245&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Similar letters indicate no significant differences, while different letters indicate significant differences.

Table 4: Effect of acidophilus plus 9*10⁶/0.1 ml and 30*10³/0.1 ml (CFU) on lowering proportion in larvae cysts of the treated occupied association with the parasite parallel to the surveillance animals within 2, 4, 6 months

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Months</th>
<th>Mice No.</th>
<th>Hydatid cysts treated</th>
<th>Reduction %</th>
</tr>
</thead>
<tbody>
<tr>
<td>10⁶</td>
<td>2</td>
<td>5</td>
<td>2.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>60</td>
</tr>
<tr>
<td>10³</td>
<td>2</td>
<td>5</td>
<td>3.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>45</td>
</tr>
<tr>
<td>Control</td>
<td>2</td>
<td>5</td>
<td>6.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>10⁶</td>
<td>4</td>
<td>5</td>
<td>1.4&lt;sup&gt;c&lt;/sup&gt;</td>
<td>82.9</td>
</tr>
<tr>
<td>10³</td>
<td>4</td>
<td>5</td>
<td>1.6&lt;sup&gt;c&lt;/sup&gt;</td>
<td>80.5</td>
</tr>
<tr>
<td>Control</td>
<td>4</td>
<td>5</td>
<td>8.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>10⁶</td>
<td>6</td>
<td>5</td>
<td>0.8&lt;sup&gt;c&lt;/sup&gt;</td>
<td>98.03</td>
</tr>
<tr>
<td>10³</td>
<td>6</td>
<td>5</td>
<td>0.8&lt;sup&gt;c&lt;/sup&gt;</td>
<td>98.03</td>
</tr>
<tr>
<td>Control</td>
<td>6</td>
<td>5</td>
<td>39.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

Similar letters indicate no significant differences, while different letters indicate significant differences.

Figure 4: Mouse infected with protoscoleces 6 months postinfection (control).

Figure 5: Mouse infected with protoscoleces and treated by acidophilus 9*10⁶/0.1 ml (CFU) 6 months.

The percentage reduction decreased in all treated mice, reached the maximum 98.03% at the dilution 9*10³/0.1 ml and 30*10³/0.1 ml (CFU) post infection 6 months (Table 4).
in mice against administrated by mouth provoked minor defense reaction, like *Schistosoma mansoni* useful bacteria in mice models against infection of (30) who proved the protective and curative effects of similar to the study of Mohamed protozoa and helminthic illness (28). These results are influence that might decrease maliciousness of numerous numberings as larval stage digit, weightiness, diameter, in addition (for both dilution), explained by significant decrease, of revealed antiparasitic effect of probiotic acidophilus plus response of the treated experimental animals. Present study infection treatment, this due to the stimulation of immune bacteria $9 \times 10^9$ respectively. In general, pre-infection treatment with continued nearly all the period of infection (2,6,8) months, with the control group, and the effect is directly fit with effect on the infection in treated animals in comparison with the control group, and the effect is directly fit with period of treatment because treatment with bacteria continued nearly all the period of infection (2,6,8) months, respectively. In general, pre-infection treatment with bacteria $9 \times 10^6/0.1$ ml (CFU) was stronger in effect that post infection treatment, this due to the stimulation of immune response of the treated experimental animals. Present study revealed antiparasitic effect of probiotic acidophilus plus (for both dilution), explained by significant decrease, of larval stage digit, weightiness, diameter, in addition increase in reduction proportion in hydatid cysts through the experiments period.

The primary route of bacterial activity to parasitic hitting possibly through boosting gut hurdle (23-26). Helpful bacteria could also increase useful microbiota numbering as *lactobacillus*, that suppress harmful bacteria development via contesting on connection region on the gut endothelial layer. Another mechanics might imply excretion of some micro killer materials, mostly produced from lactic acid bacteria and could be hold potency against parasitic larvae (27). Moreover, bacterial output holds anthelmintic influence that might decrease maliciousness of numerous protozoa and helminthic illness (28). These results are similar to the study of Mohamed *et al* (29) and Zowail *et al* (30) who proved the protective and curative effects of useful bacteria in mice models against infection of *Schistosoma mansoni* (29-31). Many strains of probiotics, like *Zymomonas mobilis* $1 \times 10^9$ CFU/ml, when administrated by mouth provoked minor defense reaction, in mice against *S. mansoni* by providing prevention in treated animals (31,32). When *Lactobacillus sporogenes* used orally at a certain dose, for a long time,since the beginning of the infestation with *S. mansoni*, minimized impairment of DNA, improves liver and gut deterioration, therefore weakened adult together with ova numbers (29).

Results of the present study are also consistent with the Bsualdo *et al* (33) who assessed the protection effects of probiotic bacteria versus Toxocariasis within experimental animals. They provoked considerable shorthand in worm number in empirical animals processed with *Enterococcus faecalis*, further, *E. faecalis* in variable dosage revealed effect against larvae outside and inside the body (25). Likewise, another study on *Trichuris muris* infection in mice model, explained that oral feeding for alive *L. rhamnosus* potentially stimulated larval expulsion in *Trichuris muris* resistant C57BL/6 mice (34). A suspension of *Lactobacillus acidophilus, L. delbruckii* revealed potential leverage against canine ancylostomiasis (16). Researchers observed that *L. casei* has anthelmintic 75-100% prophylactic effect, and *Lactobacillus plantarum P164* (17) revealed 90% protection against *T. spiralis*, ensured that these strains are safe as protective and curative probiotics (17,23,35,36), A suspension for different probiotics revealed an increased worthy preservation 90% against *Anchyllostoma caninum* infection in dogs (16), otherwise, *Bifidobacterium animalis* 04450B dose $9 \times 10^2$ CFU showed less protection 33% decrease of adult worms and 21% decrease of egg production *Strongyloids venezuelensis* infection in mice (37). First of all, we used orally administration with probiotic bacteria in experimental animals, but we didn’t see significant or obvious results that ensure the effect of bacteria as stimulative, when compared with the control group, so we used intraperitoneally injection because larval stages (hydatid cysts) are extraintestinal, so that the effect of intraperitoneal injection was very effectively obvious than oral administration. When we compared our study with others, we saw that little studies only used the intraperitoneal injection with bacteria like Babesia, *plasmodium* (protozoa) (13). Differences in the effect of probiotics strains, may be due the variable study design,

### Table 5: ANOVA analysis explain the effect of acidophilus plus dilutions $9 \times 10^6/0.1$ ml and $30 \times 10^3/0.1$ ml (CFU) on weights, Diameters, numbers means of larval stages of invaded band with the differentiated with the monitoring set

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Animals No.</th>
<th>df</th>
<th>Weight (gm)</th>
<th>Cysts No.</th>
<th>Cyst Wt. (gm)</th>
<th>Cyst diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td>5</td>
<td>2</td>
<td>68.00**</td>
<td>1176.1**</td>
<td>0.115*</td>
<td>1.157*</td>
</tr>
<tr>
<td>$10^6, 10^3$ verse control</td>
<td>5</td>
<td>1</td>
<td>107.80**</td>
<td>2351.1**</td>
<td>0.219**</td>
<td>2.289**</td>
</tr>
<tr>
<td>Durations</td>
<td>5</td>
<td>2</td>
<td>327.18**</td>
<td>382.4**</td>
<td>0.068</td>
<td>0.6117</td>
</tr>
<tr>
<td>Linear</td>
<td>5</td>
<td>1</td>
<td>584.32**</td>
<td>537.0**</td>
<td>0.137*</td>
<td>0.4222</td>
</tr>
<tr>
<td>Square</td>
<td>5</td>
<td>1</td>
<td>70.04*</td>
<td>227.2*</td>
<td>0.00007</td>
<td>0.8013</td>
</tr>
<tr>
<td>Bacteria in periods</td>
<td>5</td>
<td>4</td>
<td>41.46*</td>
<td>528.2**</td>
<td>0.0429</td>
<td>0.2712</td>
</tr>
<tr>
<td>Empirical error</td>
<td>5</td>
<td>36</td>
<td>8.06</td>
<td>34.7</td>
<td>0.03</td>
<td>0.306</td>
</tr>
</tbody>
</table>

* refers to significant at 5%, ** refers to Significant at 1%, df mean degree of freedom.

### Discussion

In the recent years, the efficiency of useful probiotics to the body rely on the mechanization, through which they do their action by numerous processes implicating manufacture of microbe killer materials, modification the mucosa of the defense order, exchange gut microflora, boosting action of enzymes (22). Both dilution of bacteria probiotic (pre and post infection) exhibited significant effect on the infection in treated animals in comparison with the control group, and the effect is directly fit with period of treatment because treatment with bacteria continued nearly all the period of infection (2,6,8) months, respectively. In general, pre-infection treatment with bacteria $9 \times 10^6/0.1$ ml (CFU) was stronger in effect that post infection treatment, this due to the stimulation of immune response of the treated experimental animals. Present study revealed antiparasitic effect of probiotic acidophilus plus (for both dilution), explained by significant decrease, of larval stage digit, weightiness, diameter, in addition increase in reduction proportion in hydatid cysts through the experiments period.

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experimental animals, dependent doses, and manner of inoculation (14).

**Conclusion**

It may well be concluded that acidophilus plus probiotics possess have an obvious stimulative and curative effect against infection with secondary hydatid disease in mice, and may be applied as an alternative strategy against different parasitic infection.

**Acknowledgement**

We would like to thank Dr. Rabie Hazem Mohammed (Department of Biology, Education College for Pure Science) for providing us with the probiotic bacteria acidophilus plus from United Kingdom.

**References**


