Fungal contamination in rainbow trout eggs in Kermanshah province propagations with emphasis on Saprolegniaceae
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Abstract
Fungal infection in the eggs of freshwater fish is well known as a problematic disease. The aim of the present study was to isolate and identify parasitic and saprophytic fungi from affected eggs of rainbow trout at two fish hatchery in Kermanshah province. The sample were inoculated in culture media (SDA,CMA,GPA and stilled water with cotton seed culture) at room temperature (18-24°C).17 species of fungi isolated from the fungal eggs. Five fungi species that isolated in this study were belonged to the saprolegniaceae family including *Saprolegnia paraitica*, *Saprolegnia lapponica*, *Saprolegnia ferax*, *Saprolegnia hypogyna* and *Saprolegnia diclina*. Another fungi that isolated in this study were, *Fusarium oxyporum*, *Fusarium npoa*, *Fusarium sp.*, *Penicilium citrinium*, *Penicillium expansum*, *Aspergillus treuse*, *Aspergillus clavatus*, *Cladosporium sp.*, *Alternaria sp.*, *Helmintosporium sp.*, *Pscilomyces sp.*, *Mocur*. It seems that *Saprolegnia parasitica* with 26.8 percent of isolation was the most important fungal infestation of egg in kermanshah trout hatcheries. Mocur with 19.6% had the most frequency after *S. parasitica* and *Fusarium*, *Aspergillus* and *Pescillomyces* with 2.45% had the lowest frequency. In this study *S. ferax*, *S. hypogyna* and *S. diclina* are reported from Iran for the first time.

Keywords: *Saprolegnia*, Rainbow trout egg, Fungal infestation

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Introduction
Over the past ten years, aquaculture has increased on average by 11% per year. Production has increased from 13 million tons of fish in year 1990 to 37.9 million tons in 2001 and 51.65 million tons in 2006 (West, 2006). The majority of global production (58%) comes from freshwater aquaculture (West, 2006). Aquaculture especially rainbow trout fish farming has been developed in Iran and fish culture now is becoming an economically important industry. Water mold infections cause losses of freshwater fish and their eggs in both nature and commercial fish farms (Bangyeekhun et al., 2001). Unfertilized fish eggs are susceptible to fungal infection particularly from the family Saprolegniaceae. During egg incubation, these fungi produce mycelia which grow and spread from the nonviable to the healthy eggs suffocating them and causing mortality (Mousavi, 2009). During recent years decreasing of rainbow trout eggs in propagation center of Iran have become common and evidences show that about half of the produced egg loses due to fungal infection (Ebrahimzadeh, 2006). Oomycetes contain some of the most devastating pathogens of animals. Taxonomically Oomycetes are divided into three subclasses: Saprolegniomycetidae, Rhiomycetidae and Peronosporomycetidae. Most fish and animal pathogen Oomycetides belong to the Saprolegniomycetidae which has two order: Saprolegniiale and Leptomitales (West, 2006). Saprolegniaceae genera particularly Saprolegnia and Achlya are generally opportunitic pathogen (Bruno & Wood, 1994) but some strains can be virulent and able to cause primary infection in fish and their eggs (Willoughby & Pickering, 1997). Identification of Saprolegnia species classically is based on morphology of the reproductive structures, i.e. antheridia, oogonia and oospores (Willoughby, 1978; Neish & Hughes, 1980). There are some reports about fungi isolation from fish and fish eggs from Iran (Ghiassi, 2007; Dakhili, 2009; Kazemi, 2009; Bozorgnia, 2009).

In this survey, for the first time, isolation of fungi along with emphasis of morphological characteristics of Saprolegniaceae from eggs of salmonid hatcheries in Kermanshah province was studied.

Materials and methods
400 infected rainbow trout eggs were collected from 2 hatcheries with temperature between 10.4-11.8°C and pH 7.5-7.8 in Kermanshah province, west of Iran during winter of 2008. Fungus-contaminated eggs were collected by sterile forceps and transferred to screw capped bottle contained sterilized tap water (STW). In laboratory the sample were washed 3 times with sterile distilled water and were placed in each egg sterilized Petri dishes containing three halves of sterilized cottonseeds and sterilized tap water, STW (volume 40ml) at then incubated at 18-24°C for 8 hours under natural light. From the growth fungi microscopic slide were taken and examined under compound microscope. In order to obtain sexual organs, some hyphae were aseptically taken out with the help of sterile...
needles and transferred to GPA (glucose peptone agar) containing 250µg/ml penicillin and 250µg/ml chloramphenicol for prevention of bacterial contamination at 18°C for at least 48-72 hours (Willoughby et al., 1984). All morphological characteristics measurements and observation under microscopic study were done. For isolation of another saprophytic fungi, Sabourodexteros agar (SDA) and Corn Meal Agar (CMA) media were used. Culture media after inoculation, incubated at 18-24°C for 24-48 hours and from colonies wet smears were done with used from lactophenol methylene blue microscopic study were done. The identification were followed by methods described by Coker & Matthews (1937), Johnson (1956), Seymour (1970), Beakes et al. (1994) and Khulbe (2001).

In table 2 some hatcheries condition during sampling were shown. Water temperature, salinity and pH were measured digitally (Multi 340i-WTW) and eggs number, infested eggs percent and infested broodstock percent were obtained manually (observation).

**Results**

Based on fungal morphological characterists 17 species of fungus were isolated from the infected eggs including *Penicillium citrinum*, *Penicillium expansum*, *fusarium poae*, *Fusarium oxysporum*, *Fusarium* sp. *Aspergillus clavatuse*, *Aspergillus treuse*, *Cladosporium* sp., *Alternaria* sp., *Helminthosporium* sp., *Pscclomyces* sp. and *mocur* sp. (Table 1). In saprolegniaceae 5 isolated species were *S. parasitica*, *S. lapponica*, *S. diclina*, *S. hypogyna* and *Saprolegnia ferax*. The morphological characteristics of the isolated Saprolegnia species are as fallow:

Withish cotton-like colonies were observed which stout hyphe especially in place of hyphe adhesion to clavate zoosporangia on GPagar. After 18 days of culture in STW on the cotton seeds at room temperature, sexual structures were formed. Lateral oogonia and spherical moderately thick, 35-45µm in diameter was observed. Antheridia did not develop in the entire culture (Fig. 1). Cotton-like whitish colony, hyphae slender, aseptate and cylindrical zoosporangia were formed on GPA. Sexual structure was formed after 8 days of culture on GPagar with cottonseeds. Terminal pyriform oogonia with centric oospore (45-70µm in diameter). Antheridia were present dindicous and laterally appressed to the oogonial wall (Fig. 2). Whitish cotton-like colonies on GPagar, abundant cylindrical zoosporangia, terminal spherical and cylindrical oogonia (90-110µm in diameter) were formed on main hyphae. Anthridia (arrow) was observed (dindicous) (Fig. 3).

Whitish cotton-like colonies on GPA and CMA (Fig. 4), hyphae moderately stout, aseptate branched (30-75µm in diameter) were observed. Zoosporangium were abundant with different shape (cylindrical, pyriform and the other) sexual structure were not observed on cottonseeds culture in STW, gemmae abundant, variable in shape, spherical and pyriforme or irregular (Fig. 5). Hyphae slender, aseptate and branched, zoosporangia filiform or clavate; oogonia terminal, lateral spherical or pyriform (50-55µm in diameter) and oospores centric (Fig. 6).
Figure 1: Oogonia of *Saprolegnia lapponica* (100x)

Figure 2: Oogonia of *Saprolegnia diclina* (100x)

Figure 3: Oogonia of *Saprolegnia ferax* (100x)

Figure 4: Oogonia of *Saprolegnia hypogyna* (100x)

Figure 5: Pyriform zoosporangium of *S. parasitica* (40x)

Figure 6: Cotton like colony of *S. parasitica*
### Table 1: Absolute and relative frequency of isolated fungi from rainbow trout eggs

<table>
<thead>
<tr>
<th>Fungi</th>
<th>Farm 1</th>
<th>Farm 2</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. parasitica</em></td>
<td>7</td>
<td>4</td>
<td>11</td>
<td>26.8</td>
</tr>
<tr>
<td><em>S. lapponica</em></td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2.45</td>
</tr>
<tr>
<td><em>S. diclina</em></td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2.45</td>
</tr>
<tr>
<td><em>S. ferax</em></td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2.45</td>
</tr>
<tr>
<td><em>S. hypogyna</em></td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2.45</td>
</tr>
<tr>
<td><em>Fusarium oxyporum</em></td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4.89</td>
</tr>
<tr>
<td><em>Fusarium poa</em></td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2.45</td>
</tr>
<tr>
<td><em>Fusarium sp.</em></td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2.45</td>
</tr>
<tr>
<td><em>Penicillium citrinum</em></td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>4.89</td>
</tr>
<tr>
<td><em>Penicillium expansum</em></td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>4.89</td>
</tr>
<tr>
<td><em>Aspergillus treuse</em></td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2.45</td>
</tr>
<tr>
<td><em>Aspergillus clavatus</em></td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2.45</td>
</tr>
<tr>
<td>Cladosporium</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>12.2</td>
</tr>
<tr>
<td>Alternaria</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2.45</td>
</tr>
<tr>
<td>Helmintosporium</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2.45</td>
</tr>
<tr>
<td><em>Psilomyces</em></td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2.45</td>
</tr>
<tr>
<td>Mocur</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>19.6</td>
</tr>
<tr>
<td>Absolute frequency</td>
<td>25</td>
<td>16</td>
<td>41</td>
<td>100</td>
</tr>
<tr>
<td>Relative frequency</td>
<td>61</td>
<td>39</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 2: Some hatchery conditions during sampling

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broodstock age (year)</td>
<td>3-5</td>
</tr>
<tr>
<td>Crowding of eggs (Number/cm²)</td>
<td>49-65</td>
</tr>
<tr>
<td>Water temperature (°C)</td>
<td>10.4-11.5</td>
</tr>
<tr>
<td>Salinity</td>
<td>0.4-0.6</td>
</tr>
<tr>
<td>pH</td>
<td>7.5-7.8</td>
</tr>
<tr>
<td>Eggs infestation (%)</td>
<td>20-42</td>
</tr>
<tr>
<td>Broodstock infestation (%)</td>
<td>30-42</td>
</tr>
<tr>
<td>Water resource</td>
<td>Spring &amp; river</td>
</tr>
</tbody>
</table>
Discussion

In saprolegniaceae family 5 isolates were S. parasitica, S. laponica, S. diclina, S. hypogyna and S. ferax. In the study in cultivated cyprinids in Iran, thirty-nine species of fungi were isolated from the gill lesions. The most important pathogenic fungi were Branchiomycetes, Saprolegnia, Fusarium, Phoma and Exophiala. The most frequency isolated fungi were Fusarium (46.4%) and Saprolegnia (25%), whereas Exophiala (3.6%) was shown the lowest frequency (Firouzbakhsh et al., 2005). In this study, like previous ones, the highest rate of infestation was related to Saprolegnia genus with 36.6% frequency. Among different isolates from eggs, S. parasitica was the most important with 26.8% frequency. It has been established that the greatest losses on fish eggs, however, are due to saprolegnia species (Willoghyby, 1970; Czeczuga & Kiziewicz, 1999 ; Hussein et al., 2001). Saprolegnia ferax was reported from different places under various ecological condition in the world (Khulbe, 2001). In this study S. ferax, S. hypogyna and S. diclina were reported from Iran for the first time. S. frax cause great losses in acipenserid hatcheries in Russia (Lartseva, 1986). Kitanchareon (1997) reported S. ferax and S. hypogyna in aquatic system and on infected salmonid fish and fish eggs from Japan. Ghiassi et al. (2007) reported S. parasitica from Rutillus frisii kutum in hatcheries in Mazandaran province, Iran. Kazemi (2009) reported five species of fungi were isolated from the Acipenser persicus larva that were included of Alternaria spp., Cladosporium spp., paecilomyces spp., penicillium spp. and chrysosporium spp.

In cases that Fusarium mostly were isolated, lower saprolegnia infestation were observed. The same result was reported by Ebrahimzadeh in rainbow trout propagation in Mazandaran province (Ebrahimzadeh et al., 2007). In the study by Ebrahimzadeh (2007) in Mazandaran province, twelve species of fungi isolated from the fungal salmonid eggs. Three of the isolated fungi were belonged to the saprolegniaceas' family including: Saprolegnia parasitica, Saprolegnia sp., Achlya sp. Other nine recognized fungi were: Penicillium, Aspergillus, Paecilomyces, Acremonium, Fusarium oxysporum, F. solani, Alternaria, Mucor and Helminthosporium. In this study three species of pathogenic fungi in aquatic were isolated, including:

Saprolegnia parasitica, Saprolegnia sp., Achlya sp. It suggested that saprolegnia parasitica with 13.18% of isolation was the most important of fungal egg infestation Mazandaran salmonid hatcheries.

Mueller in a same study showed that in water culture media Fusarium prevents growth of Saprolegnia (Pickering et al., 1994). Totally in this study, 17 fungi species were isolated respectively with higher infestation by Saprolegnia. There were some noticeable differences between studied hatcheries. Frequency of fungal infestation in farm 1 and 2 were 61 and 39% respectively that the same ratio (2/1) was shown macroscopically. It can be
concluded that collecting fungal eggs (can prevent from spread of contamination to healthy eggs), inhibiting high density of eggs in incubators, maintaining physical and chemical quality of water, brood stock age and health are the main factors to control fungal diseases in fish farms. Ecological differences resulting from different hatcheries conditions (chemical factors, age of bloodstock, eggs crowded, ect) may have played a role of the fungi that developed on rainbow trout eggs in the present study. Although environmental variables were not studied directly, they are known to influence the growth, reproduction and intensity of aquatic fungal infection (Richards & Pickering, 1978; Willoughby, 1994). Alabi (1971) observed that the occurrence of Saprolegniaceae correlated with some parameters of water (i.e., temperature, pH, ionic concentration and organic content). There is no doubt that ecological differences play an important role in the species diversity of the fungi that develop on both fish and eggs (Willoughby, 1986; Hussein et al., 2001). There are some report that showed water quality, crowded hatchery conditions, pollution and water temperature changes can causes of Saprolegniasis in fish and fish eggs (Pickering, 1994; Bruno, 1999; Sniezko, 1974; Beakes et al., 1994). Higher infestation in farm 2 might be related to lower age of brood stocks but there was not any relation with infestation in eggs. It is note worthy that in farm 2 all infected eggs were collected daily but in farm 1 it was done once a week. So by keeping in mind that Saprolegnia genus was the most important one it can be concluded that Saprolegniaceae is the pioneer in affecting rain bow trout eggs.

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مطالعه آلودگی‌های قارچی در تخم‌های قزل آلای رنگین
کمان

مراکز تکثیر استان کرمانشاه با تاکید بر
سابرولگنیاسه
نسترن شهبازیان؛ حسینعلی ابراهیم زاده موسوی؛ مهدی
سلطانی؛ علیرضا خسروی؛ سعید میرزغرد و عیسی شریفی‌پور

تاریخ دریافت: اردیبهشت ۱۳۸۸
تاریخ پذیرش: تیر ۱۳۸۸

چکیده
عفونت‌های قارچی بعنوان یکی از بی‌گاری‌های مهم در تخم‌های آب‌شیرین به‌خوبی شناخته شده است. هدف از
این مطالعه جداسازی و شناسایی قارچ‌های سابرولگنیتی از تخم‌های آب‌شیرین کمک را در دو مرکز تکثیر استان
کرمانشاه می‌باشد. در آیین بررسی‌ای از ۴۰۰ تخم قزل زده نمونه در انجام شد و در محیط کشت‌های سابرولگنی
گلوریک پیوند آآن و کرون میل آگار به همراه پینه داده در دمای محیط (۲۴ درجه سانتی‌گراد) تحت داده شد. در این
مطالعه ۱۷ نوع قارچ براسا مشخصاتی تحت فشار گردید که ۵ نوع مرتبط به خانواده سابرولگنیا اس‌تا
بودند و در این بین: سابرولگنیا باراژی‌نا کا، سابرولگنیا لابیونیا، سابرولگنیا هالی بوجی‌نا، سابرولگنیا دی‌کلی‌نا و
سابرولگنیا فراکس در دو مرکز تکثیر استان کرمانشاه جد شد. بررسی نمونه‌ها از فوزوارم اکسی‌ساروم، فوزوارم بی‌گونه
فوژوارم، پنی سی‌ی‌یوم سنتری‌یوم، پنی سی‌ی‌یوم اکسی‌ساتوم، آسپیرژیولوس، آسپیرژیولوس ترونو، آسپیرژیولوس کلاراوت،
کلاراوت، اوژنیا، هالی‌نبیوسوریوم، پسی‌لومیلیس و مکور، بنظر می‌رسد که سابرولگنیا باراژی‌نا با درصد
۴۶/۸ درصد می‌باشد. قارچ دومین قارچ زده تخم‌های آب‌شیرین کمک در دو مرکز تکثیر استان کرمانشاه می‌باشد.
مکور با درصد ۱۹/۶ درصد بعد از سابرولگنیا باراژی‌نا کا، بی‌شیرینی، موارد جداسازی و قارچ‌های فوزوارم، آسپیرژیولوس و
پسی‌لومیلیس با درصد ۳۲ درصد کمترین فراوانی را داشتند.
در این مطالعه برای اولین بار قارچ‌های سابرولگنیا هالی بوجی‌نا، سابرولگنیا دی‌کلی‌نا و سابرولگنیا فراکس از ایران
گزارش می‌گردد.
کلمات کلیدی: سایروگنی، تخم قزل آبادی رنگین کمان، عفونت فارچی