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Synergistic effects of various acidity and salinity levels on survival juveniles of two fish carps (*Cyprinus carpio* L. and *Ctenopharyngodon idella* Val.) during exposure for 96 hrs.

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Abstract:

The effects of extreme acidity and salinity on survival of juveniles for two carp species common carp (*Cyprinus carpio* L.) and grass carp (*Ctenopharyngodon idella* Val.) were investigated. The juveniles were exposed to five different degrees of acidities (6.4, 5.8, 5.2, 4, 3.4), and the control waters with 7.6 pH & 1.03 S‰. The second experiments was conducted by using two different salinities (Low = 0.09 ‰ and High=20.5‰) during 96 hrs.

The result statistical analyses (by using SPSS program) were showed that the juveniles of *Cyprinus carpio* were less resistant to different acidity values compared with *Ctenopharyngodon idella.* The LC50 pH values were 6.1 and 6 for common carp and grass carp respectively, but in the case of synergistic effects showed that *Cyprinus carpio* have more resistance than *Ctenopharyngodon idella*, their LC50 pH values were 4 (at low S‰), 5.35 (at high S‰), and 5.2 (low S‰), 5.5(at high S‰) respectively.

Keywords: Synergistic effects; Extreme pH; Carp juveniles; exposure; Common carp; Grass carp; LC50.

Introduction:

Although extreme pH values are deleterious to aquatic organisms, the pH range 6-9 is generally considered acceptable to most species (Rahel, 2006). Within this range, however, the toxicity of many poisons influenced by pH. Particularly strongly affected are those poisons which dissociate into ionized and unionized fractions, of which one is markedly more toxic than the other. The best known example is ammonia (Alabster & Lloyed, 1990) this is more toxic at high pH values.

In fact, the aquatic environments and their biota are effected when the hydrogen ions were decreased. In this case, there are many accidents that may happen to different aquatic species in many lakes causing fish mortality in different countries such as Canada, Australia and America (Kalinin, 1999).

Bio-composition of water include different kinds of biota such as phytoplankton, zooplankton, hydrophytes, amphibian, fishes and others, Edward (1984) pointed that all these biota all these biota and environmental factors are also will be affected by water acidity especially water salinity. an experiments were done in one artificial lake in Sweden for seven years observations, when acidity was 5.4 caused increase in growth of blue green algae more than other plant species with low salinities (Ellis,1982).

Other studies stated that no fishes were found in water of low acidity and high salinity (Kalinin, 1999).

The aim of this study was to determine the effects of increasing of hydrogen ions (different levels) in the water on survival of juveniles of two fish carps (*Cyprinus carpio* L. and *Ctenopharyngodon idella* Val.) during their exposure for 96 hrs.

Materials and Methods:

Juveniles of two Cyprinids fishes were used (*Cprinus carpio* L. and *Ctenopharyngodon idella* Val.), juveniles were supplies from 'Marine Science Center Aquaria "they were caught by using net with 5 mm mesh size (mean length about 4 cm. and mean weight about 1.1 g). They were kept in well-aerated aquaria (30 x 30 x 60 cm.) in the laboratory for about five days for acclimatization.

The range of laboratory temperature were 30-33 °C, juveniles were feed daily with diet (supplies from fisheries department) during the acclimatization periods (Brown, 1990).

Two types of experiments have been designed using plastic containers, 3 liters of water were added to each container, either as controls (pH value 7.2 ± 0.2 and salinity 1.02 ± 0.02. First set of experiments were prepared different acidity values (acidity were: 6.4, 5.8, 5.2,4 and 3.4) by adding distil water, with 3 replicates by used pH meter called "HANAH INSTRUMENTS, HI 9811-0" made in Portugal. The second set of experiments include two different salinities (0.09 - 20.5‰) as recommended by Haines (2006) in order to know synergistic effects of different acidity levels with salinities compared with control experiments.

Results:

Present acidity degrees have been chosen due to the "acidity scales" as shown in fig. (1), the range of acidity

scales some times about 5.6 due to formation of weak acid (H2CO3) through the reaction of carbon dioxides with the atmospheric moisture (Baker and Schofield, 2006):

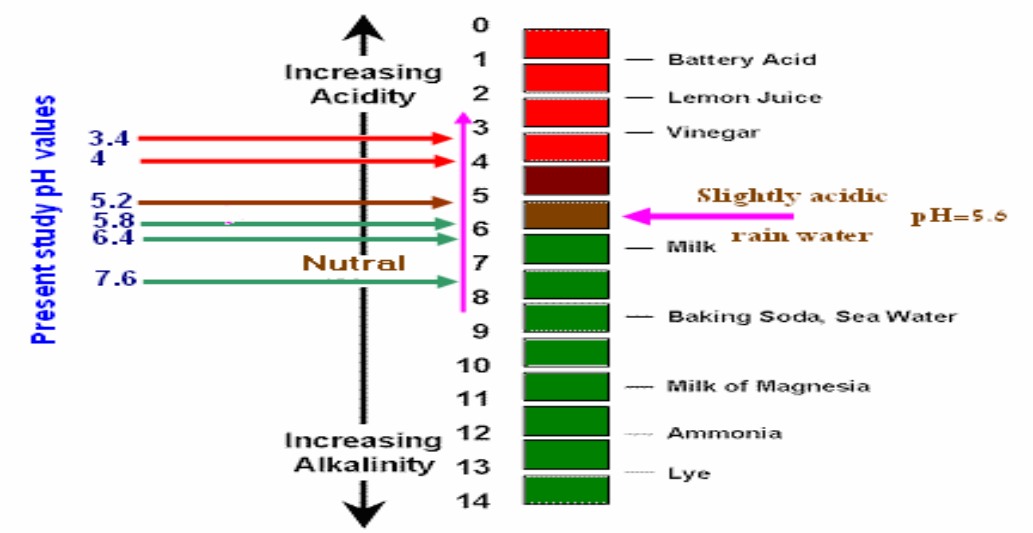

Fig. (1) The acidity values used in present study compared With various acidity values

Fig. (2) showed the survival percentage of juveniles for common carp (A) and grass carp (B) juveniles. The results showed that common carp have a little resistant to the different acidity degrees compare with grass carp juveniles. When juveniles were exposed to two salinity concentrations, the results showed that juveniles of common carp have a more resistance than grass carp juveniles (Fig.3).

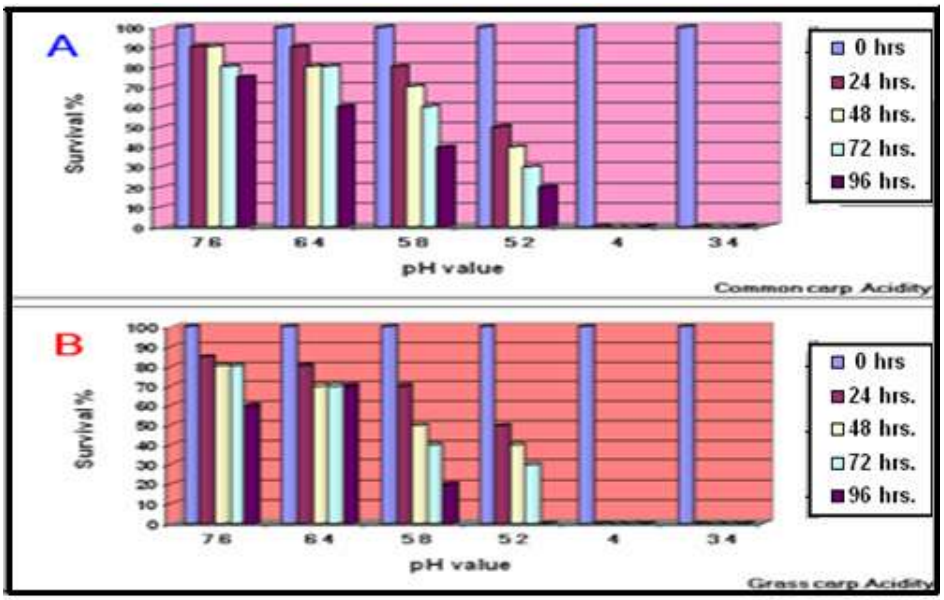

Fig.(2) showed the effects of acidity on survival of (A) common carp and (B) grass carp

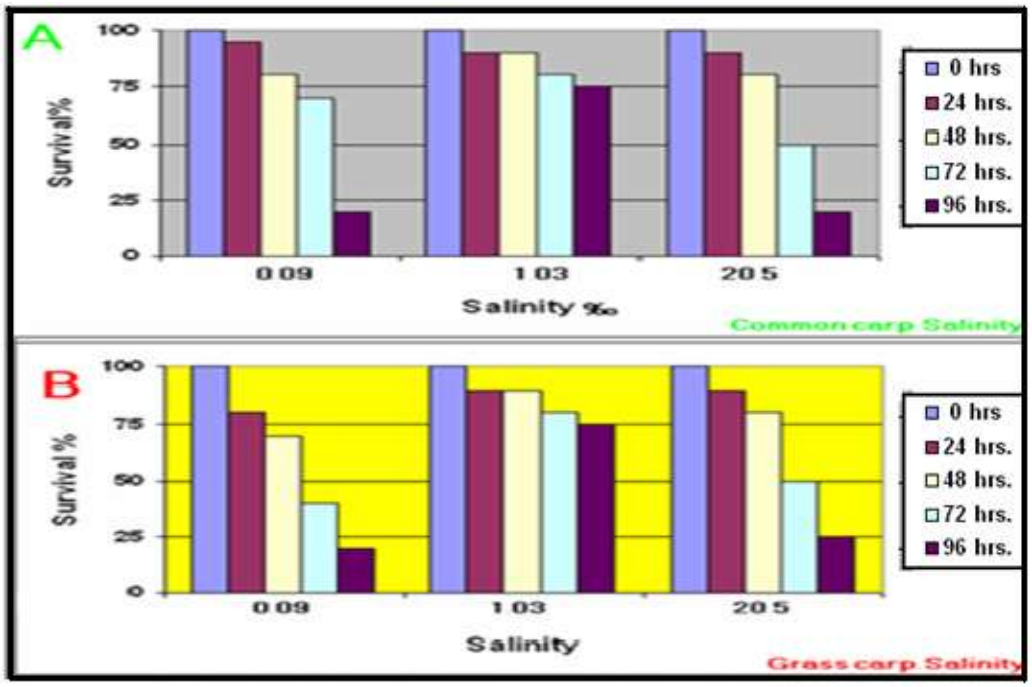

Fig.(3) effects of salinity on survival of (A) common carp and (B) grass carp

In the case of synergistic effects (Acidity and salinity), in general, an increase of water salinity (either less or more than control salinity) will reduce the effects of acidity on survival of grass carp juveniles, in the same time low salinity (0.09‰) will be also reduced the effects more than in the case of high salinity (20.5‰), figs. (4, 5, 6, 7). Fig. (8) showed the range of synergistic effects of acidity and salinity. Fig. (9) showed the comparisons of different effects between present study and previous studies.

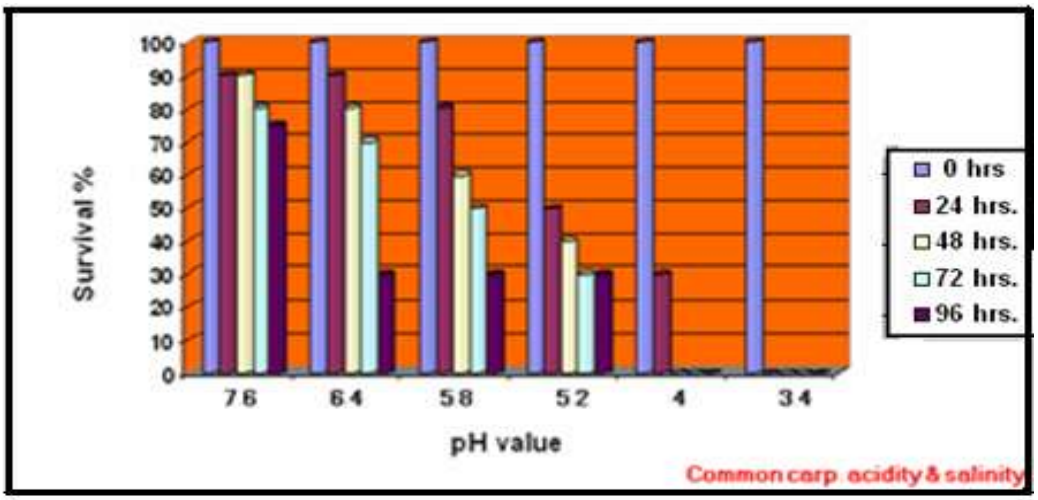

Fig.(4) synergistic effects of acidity and low salinity on survival of common carp

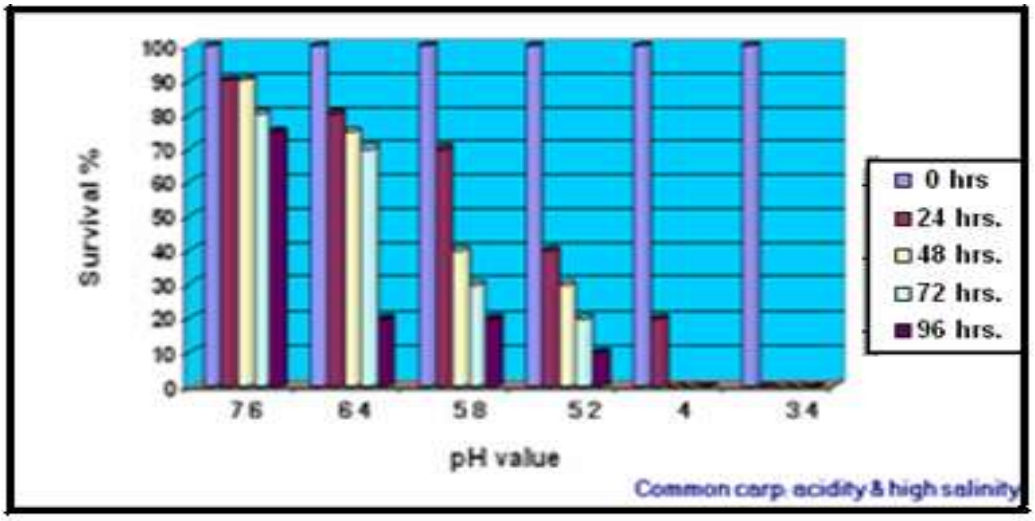

Fig.(5) synergistic effects of acidity and high salinity on survival of common carp

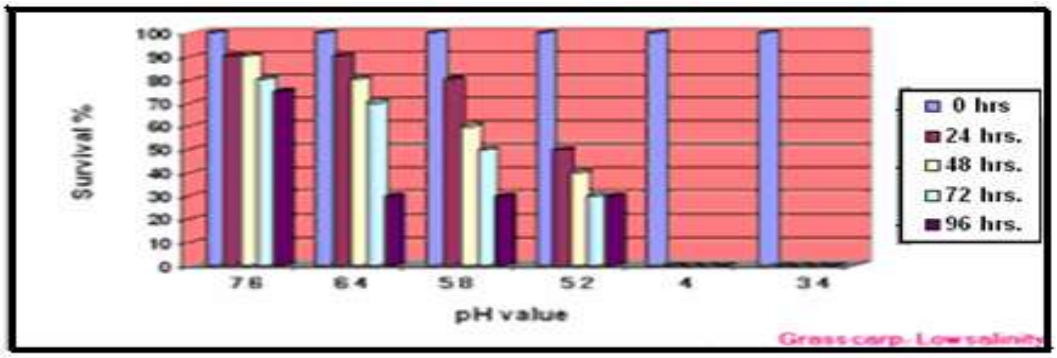

Fig.(6) synergistic effects of acidity and low salinity on survival of grass carp

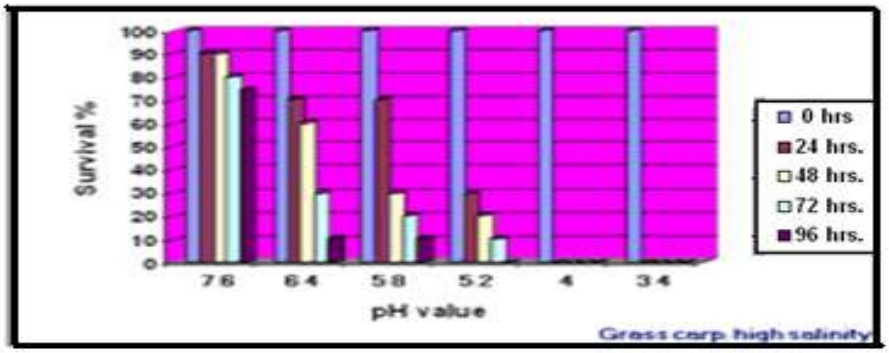

Fig.(7) synergistic effects of acidity and high salinity on survival of grass carp

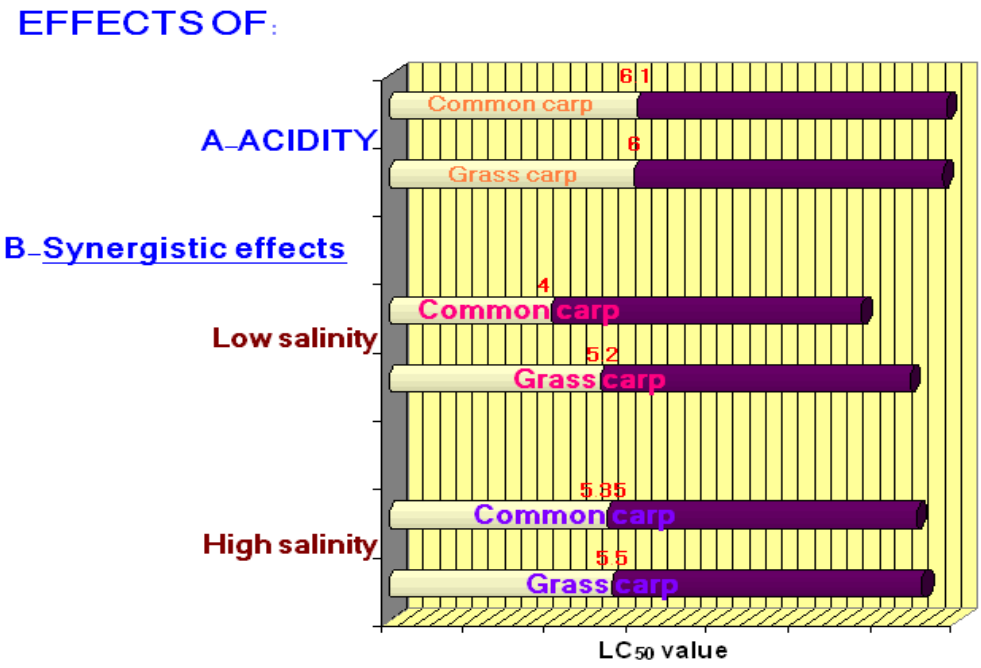

Fig.(8) comparison between synergistic effects of acidity and salinity on survival of common carp and grass carp

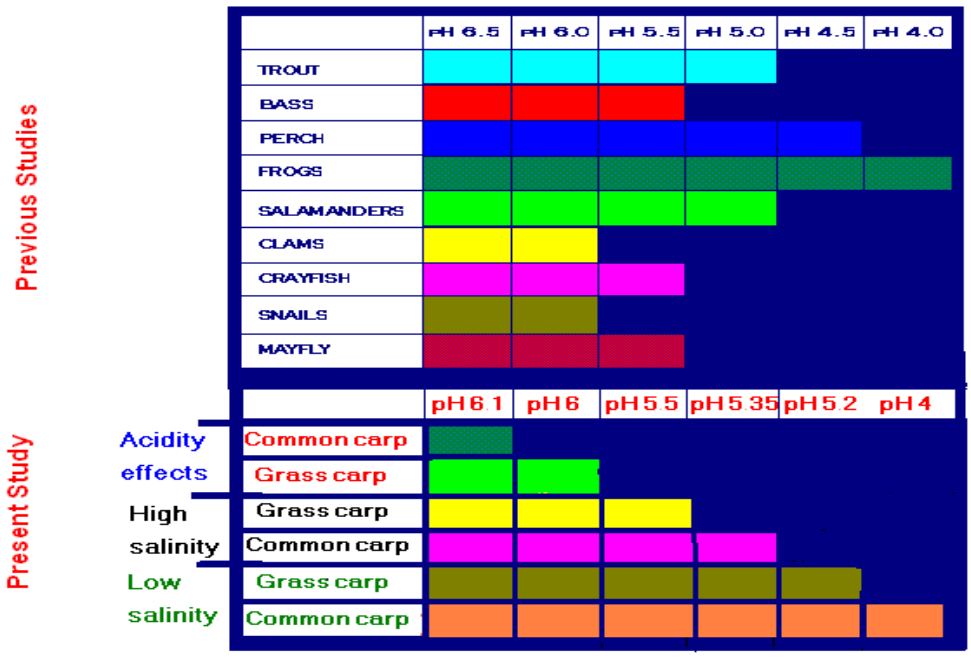

Fig.(9) comparison of different effects between present study and previous studies (website, 2007)

The LC50 values were determined by using logarithmic probate lines as a common denominator as used by (Abdul-Hassan, 1983). Statistical analyses by "SPSS programs" have been used to determine significant differences between different results. During the exposure periods, the bleeding from fish gills increase with exposure time and pollutant level, and in some cases, the abdominal explosion had been happen.

Discussion:

It is generally accepted that as pH decreases, both the diversity of species and the overall productivity of aquatic ecosystems declines. These phenomena can readily be observed through contemporary studies on waters of different pH values. The range of acidity which is not harm to the ecosystems may be considered broadly acceptable (Alabaster & Lloyd, 1990) that does not mean that pH changes within the range 5-9 are of no consequence. For example, pH is an important determinant of the distribution patterns of aquatic species.

The effects of different acidity and salinity levels in the present study showed a wide range of toxicity depending on the level and exposure time for each juvenile species.

It is very clear that the effects of acidity on survival of two juvenile's species (Fig 2), grass carp juveniles showed a more resistant than common carp juveniles during expose time. Green (2005) reported same results when the juveniles of three carp species had been exposed to some pollutants.

Figs. (4, 5, 6, 7) showed the decline in the effects during the exposure time, when the juveniles for both fish species, especially at low salinities. This indicated that the salt ions may be react with acid ions to produce new compounds which have less effects on juvenile survival, these results were agreed with many studies (Scullion and Edwards, 1980; Aoyama, et.al., 1987; Baker and Schofield, 2006; Haines, 2006).

Many studies were mentioned about the mortality of different aquatic biota due to the increasing of hydrogen ions such as effects on embryos and juveniles of Atlantic salmon fry which have been observed to die when water with pH < 5 was introduced into breeding pools (Baker and Schofield, 2006).

Davis (2003) reported that in fish embryos, death appears to be due to corrosion of epidermal cells by the acid. Acidity also interferes with respiration and osmoregulation. In all fish at a pH of 4 to 5 the normal ion and acid/base balance is disturbed. Na^+ uptake is inhibited in low pH waters with low salinity. Small fish are especially affected in this way because due to their greater ratio of body and gill surface area to overall body weight, the detrimental ion flux proceeds faster. In all fish, low pH water causes extensive gill damage. Most of gill lamina eroded, gill filaments swell, and edemas develop between the outer gill lamellar cells and the remaining tissue, and at pH <3 coagulation of mucus on gill surfaces clogs the gills, which leads to anoxia and subsequent death.

Conclusions:

- The juveniles of common and grass carp have been affected by different levels of acidity.
- Grass carp juveniles showed a little more resistance to different acidity values than common carp.

- In the effects of salinity common carp was a little more resistance than grass carp.
- During the synergistic effects, common carp was more resistance than grass carp in low salinities, but in high salinities, both species had same effective of acidity degrees.
- Acidity have been affected by salinity, at low salinities, both species had more resistance in those in either acidity or acidity with two salinities. At high salinities, fishes were more resistance than those at acidity only.

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التأثير المشترك للحامضية والملوحة على بقاء يافعات نوعين من اسماك الكارب الاعتيادي *Cyprinus carpio* والكارب العشبي *Ctenopharyngodon idella* خلال تعرضهما لمدة ٩٦ ساعة.

المستخلص:

تمت دراسة التأثير المشترك من الحامضية الملوحة على بقاء يافعات نوعين من اسماك الكارب الشائع (***Cyprinus carpio* L**) والكارب العشبي (***Ctenopharyngodon idella* Val.**) .عرضت اليافعات الى خمس قيم من الحامضية (3.4,4,5.2,5.8,6.4), بالإضافة إلى تجارب السيطرة (7.6 حامضية و 1.03‰ ملوحة) ولتركيزي من الملوحة المنخفضة (0.09 ‰) والمرتفعة (20.5 ‰) ولمدة 96 ساعة.

نتائج التحليل الاحصائي(باستخدام برنامج SPSS الاحصائي), اوضحت بأن يافعات الكارب الاعتيادي هي اقل مقاومة بقليل الى قيم الحامضية من يافعات الكارب العشبي, والحامضية المحتمل أن تقتل نصف عدد الأسماك (LC50) هي 6 و 6.1 على التوالي، لكن في حالة التأثيرات المشتركة أوضحت النتائج بأن الكارب الاعتيادي هو أكثر مقاومة من الكارب العشبي، والحامضية التي تقتل نصف العدد(LC50) هي 4 بانخفاض الملوحة ،5.35 بارتفاع الملوحة و 5.20 بانخفاض الملوحة, 5.5 بارتفاع الملوحة على التوالي.