

The effect of formalin, alcohol and freezing on some body proportions of *Alepes djeddaba* (Pisces: Carangidae) collected from the Red Sea coast of Yemen

Efecto de formalina, alcohol y congelamiento en algunas proporciones corporales de *Alepes djeddaba* (Pisces: Carangidae) recolectados en la costa del Mar Rojo de Yemen

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Resumen.- Se investigó el efecto de formalina, alcohol y congelamiento en las proporciones de tres partes del cuerpo en el pez *Alepes djeddaba*.

Las técnicas de preservación tuvieron diferente efecto en la longitud total, estándar y de la cabeza de *A. djeddaba* recolectados en la costa del mar rojo de Yemen. Las técnicas de

preservación y congelación no afectaron la morfología de los peces en 8 de 21 pruebas. Se observó encogimiento en siete casos y un aumento en las proporciones del cuerpo en seis casos.

Palabras clave: Morfología, efectos de preservativos, República de Yemen

Introduction

Various preservatives and preservation techniques are used to preserve fish specimens so that they are available for further studies, e.g. biosystematics work. Formalin, alcohol and freezing are the standard ichthyological preservatives.

Body proportions of preserved fish showed variable degrees of change after a standard period of preservation in various preservatives. Most authors have reported a decrease in length (Lux 1960; Parker 1963; Stobo 1972; Engel 1974; Sayers 1987), but Billy (1982), Al-Hassan & Abdullah (1992), Al-Hassan & Al-Shawafi (1997) and Al-Hassan *et al.* (1999, 2000) reported a slight increase length or at least no shrinkage in preserved specimens of *Sarotherodon mosambicus*, *Barbus luteus* and *Rastrelliger kanagurta* respectively.

In Yemen, only Al-Hassan & Al-Shawafi (1997) have studied the effect of preservatives on body proportions of the fish *Rastrelliger kanagurta*. The present work examines the effect of different concentrations of formalin and alcohol and the effect of freezing on selected morphological characters of the fish *Alepes djeddaba* (Forsskal, 1775).

Materials and Methods

Seventy specimens of *Alepes djeddaba* were obtained from Houdaida province of the Red Sea coast of Yemen. Fish of as near equal size and age as possible were chosen to obviate size and age effects (standard length (SL) range 160-170 mm, estimated to be two years old). Measurements were taken within an hour of capture. Specimens were divided in seven lots of 10 fish to be used for formalin, alcohol and freezing experiments. Preservative solutions were prepared as follows: two lots of 5% formalin, two lots of 10% formalin and two lots of 70% ethanol, each pair of lots being mixed with tap and distilled water. The seventh lot was used for the freezing experiment, for which a one cubic metre commercial deep freeze unit was used. Body dimensions chosen were total length (TL), standard length (SL) and head length (HL) (widely used by taxonomists and fisheries biologists), giving a total of 21 experimental variables. Each specimen was measured weekly over a fifteen-week period. Duncan's multiple test was applied to examine the effect of different preservatives and freezing on body proportions (Harraway 1997).

Results and Discussion

The different concentrations of formalin and alcohol besides freezing showed different degrees of effects on the three dimensions of *A. djeddaba* chosen for the study (Table 1). Three types of effect were observed: shrinkage, increase in body length and no effect. Of the 21 experiments, shrinkage was observed in seven, increase in total length in five and no detectable effect in nine.

The greatest shrinkage was noticed in specimens preserved in 5% formalin-tap water (6.27%) while the least shrinkage was in fishes stored in 70% alcohol-tap water.

Table 1

Effects of different preservatives and freezing on selected morphological characters of *Alepes djeddaba*. DW, distilled water; TW, tap water; TL, total length; SL, standard length; HL, head length; NE, no effect

Efectos de diferentes preservativos y congelación de caracteres morfológicos seleccionados de *Alepes djeddaba*. DW, agua destilada; TW, agua potable; TL, longitud total; SL, longitud estándar; HL, longitud de la cabeza; NE, sin efecto

Morphological characters	Preservation methods and freezing	%	Effect
TL	5% formalin-TW	6.27	Shrinkage
TL	10% formalin-DW	5.41	Shrinkage
TL	70% alcohol- TW	0.88	Shrinkage
TL	70% alcohol-DW	2.20	Shrinkage
HL	5% formalin-DW	1.28	Shrinkage
HL	10% formalin-DW	3.14	Shrinkage
HL	Freezing	0.97	Shrinkage
SL	5% formalin-TW	0.96	Increase
SL	5% formalin-DW	0.84	Increase
SL	70% alcohol-TW	14.50	Increase
SL	70% alcohol-DW	17.30	Increase
TL	Freezing	12.43	Increase
SL	10% formalin-TW	-	NE
SL	10% formalin-DW	-	NE
SL	Freezing	-	NE
TL	10% formalin-TW	-	NE
TL	5% formalin-DW	-	NE
HL	10% formalin-TW	-	NE
HL	70% alcohol-TW	-	NE
HL	70% alcohol-DW	-	NE
HL	5% alcohol-DW	-	NE

Within the shrinkage experiment, total length of the fish showed some variation. In the 5% formalin-tap water solution, measurements were stable until the seventh week of preservation, after which a clear shrinkage occurred at week eight and continued steadily until the tenth week of the experiment. In the 5% formalin-distilled water solution, a slight shrinkage was observed at the third week of preservation, followed by a slight fluctuation during weeks 5 and 7, the shrinkage effect became stable in week 8 and remained thus until the end of the experiment. In both 70% alcohol solutions, shrinkage was continuous, commencing from the second week of experimentation (70% alcohol-tap water) and from the third week (70% alcohol-distilled water). The shrinkage effect started to stabilise in week 8 (70% alcohol-tap water) and in week 7 (70% alcohol-distilled water solution).

On the other hand, steady shrinkage in head length was recorded in fishes preserved in 5% formalin-distilled water while there was a sudden shrinkage in the second week and then slight fluctuations in specimens kept in 10% formalin-distilled water.

Increases in standard length were greatest in those fish groups preserved in 70% alcohol-distilled water (17.3%), and least in those kept in 5% formalin-distilled water (0.84%).

Among the selected parameters, standard length tended to increase when fish specimens were preserved by freezing. Increase in standard length was observed in both 5% formalin and both 70% alcohol solutions. Incremental change was steady in the formalin solutions and dramatically increased in the alcohol solutions, especially at the third week of preservation.

The only case of increase in total length occurred in fish kept frozen. Length remained stable until the sixth week of freezing and then a big change occurred in the seventh week (Fig. 1).

The statistical analyses showed significant differences between degrees of shrinkage in total length occurring in 5% formalin-tap water, 10% formalin-distilled water solutions, and both 70% alcohol solutions. Within the formalin concentrations (5% and 10%), shrinkage in total length was not significant ($P>0.05$). However, there was a significant shrinkage in the total length of fishes kept in both 70% alcohol solutions ($P<0.05$). Significant shrinkage was observed in the head depth of fishes preserved in both formalin concentrations of distilled water and those kept under freezing ($P<0.05$).

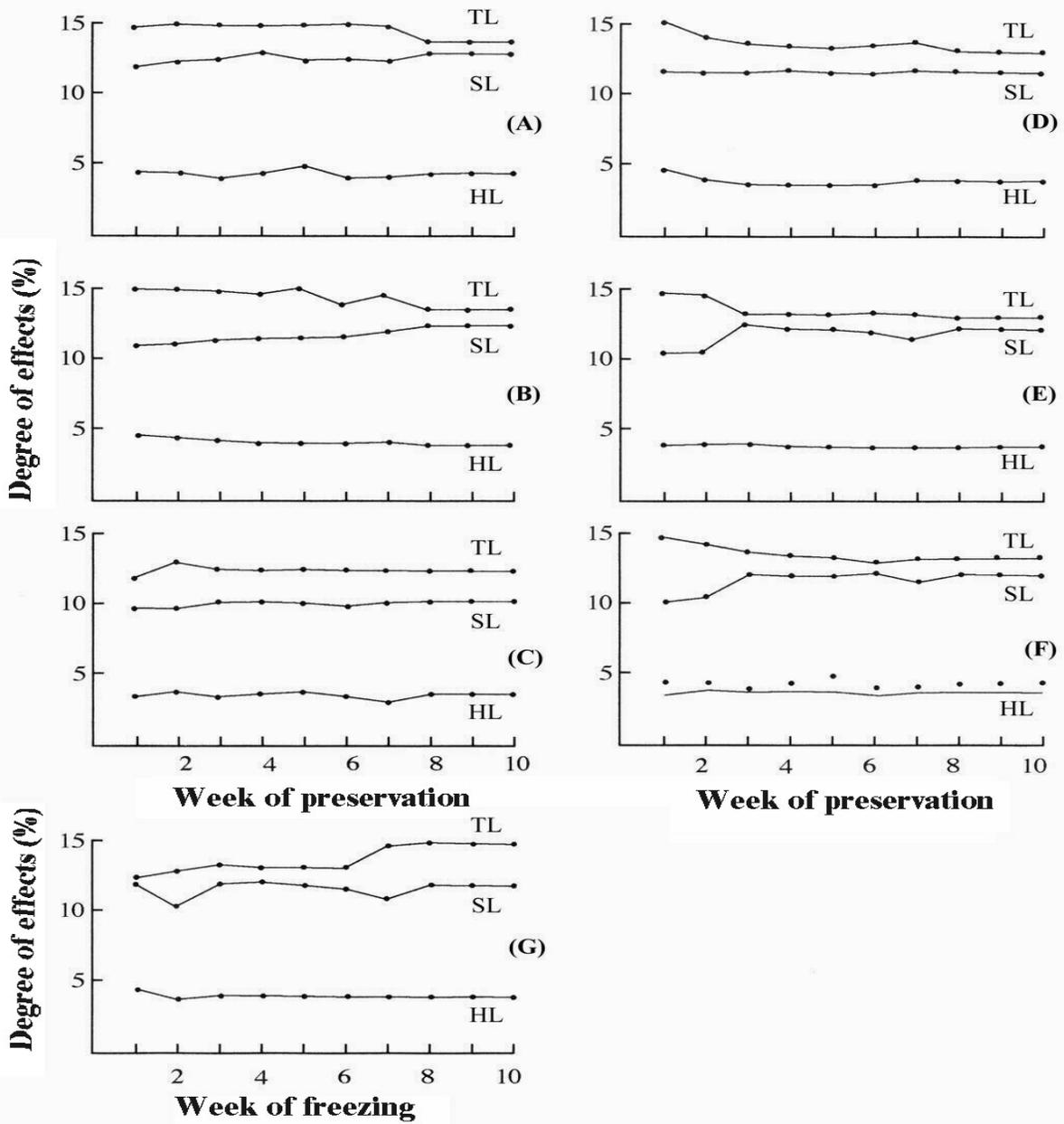


Figure 1

The relationship between different body proportions of *Alepes djeddaba* and number of weeks of preservation (A-F) and freezing (G). A, 5% formalin in tap-water; B, 5% formalin in distilled water; C, 10% formalin in tap-water; D, 10% formalin in distilled water; E, 70% alcohol in tap-water; F, 70% alcohol in distilled water; HL, head length; SL, standard length; TL, total length

Relación entre diferentes proporciones corporales de *Alepes djeddaba* y número de semanas de preservación (A-F) y de congelación (G). A, formalina al 5% en agua potable; B, formalina al 10% en agua destilada; C, formalina al 10% en agua potable; D, formalina al 10% en agua destilada; E, alcohol al 70% en agua potable; HL, longitud de la cabeza; SL, longitud estándar; TL, longitud total

Significant increase in standard length of the fish occurred in specimens kept in both 70% alcohol solutions ($P < 0.05$), while there was no significant difference in standard length of the fish preserved in both formalin solutions. A significant difference in standard length was noticed between fishes from both 70% alcohol and both 5% formalin experiments ($P < 0.05$). Increases in total length due to freezing were significantly different from those of the 5% formalin and the 70% alcohol experiments ($P < 0.05$). These results agree with those of Lux (1960), Parker (1963), Stobo (1972), Engel (1974) and Sayers (1987).

Every other study has reported shrinkage with preservation. It would appear that the preservation techniques used here significantly alter body proportions in the fish *A. djeddaba*. In some cases, shrinkage presumably occurs at a much slower rate than in the time period studied here, and a longer time could reveal detectable shrinkage. These results are in accordance with those of Billy (1982) for *Sarotherodon mossambicus*, and Al-Hassan & Abdullah (1992) for *Barbus luteus*, in which they reported slow changes in the fish body proportions due to preservatives.

The correlation between increase and decrease in standard length could be due to variation in tissue water content and the ratio of white to red muscle, different parts of the body containing different proportions of white and red muscle according to the role they play in swimming. These differences in chemical composition/water content between different parts of the fish body will be reflected in differential post mortem shrinkage (Leslie & Moore 1986).

The effect of different preservatives on the morphology of fishes in relation to size has been the subject of several papers (Burgner 1962, Stobo 1972). However, their findings are not accordant to the present results, and nor were the freezing effects reported by Sayers (1987).

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