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References

Fiske C.H and Subbarow Y. 1925. The colorimetric determination of phosphorous. Journal of Biological Chemistry 66:376–400.

Hirimuthugoda N.Y., Chi Z.M. and Zhu K.L. 2006. Probiotics and sea cucumber farming. SPC Beche-de-Mer Information Bulletin 24:45–48.

Kurtzman C.P. and Fell J.W. 1998. The yeasts, a taxonomic study, fourth edition. Amsterdam, the Netherlands: Elsevier. p. 915–947.

Pandy A., Szakas G., Soccol R.C., Rodriguez-Leon J.A. and Soccol, T.V. 2001. Production, purification and properties of microbial phytases. Bioresource Technology 77:203–204.

Raibaud P. 1992. Metabolic interactions in the gut. p. 29–53. In: Fuller R. (ed). Probiotics, the scientific basis. London: Chapman and Hall.

Sambrook J., Fritsch, E.F. and Maniatis, T. 1989. Molecular cloning, a laboratory manual. Cold Spring Harbor Laboratory Press.

Vohara A. and Satyanarana T. 2001. Phytase production by the yeast *Pichia anomala*. Biotechnology Letters 23:551–554.

Vohara A. and Satyanarayana T. 2004. A cost effective molasses medium for enhanced cell bound phytase production by *Pichia anomala*. Journal of Applied Microbiology 97:471–476.

An observation on the effect of environmental conditions on induced fission of the Mediterranean sand sea cucumber, *Holothuria arenicola* (Semper, 1868) in Egypt

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Introduction

Holothuria arenicola is the most important and abundant sea cucumber species in the Mediterranean Sea on the Egyptian coast (Fig. 1A). It was recorded in 1984 for the first time on the Egyptian Mediterranean coast (Shoukr et al. 1984). Its habitat extends from the Indo-Pacific to the tropical Western Atlantic. Its reaches a size of about 26 cm. Presently, *H. arenicola* is overexploited in Egyptian waters due to the increasing demand from Asian markets. The loss of sea cucumber stocks is likely to have a significant negative impact on the ecosystem and the adjacent marine environment as a whole. Therefore, there is an urgent need for intensive studies of the biology, culture and fishery management of *Holothuria arenicola*.

Some holothurians are known for their ability to reproduce asexually by fission. Most holothurian species with asexual reproduction follow the twisting and stretching mode (Uthicke 2001). The first trial to induce asexual reproduction in *H. arenicola* was done by Kilada et al. (2000), who investigated the induction of asexual reproduction by using rubber bands. The present work aims to describe the stages of asexual reproduction by fission and the effect of environmental factors on dividing and survival rates.

Method

Asexual reproduction of *H. arenicola* was induced by fitting rubber bands just in front (the upper 45%) of the middle portion of the body (Fig. 1B). Specimens were kept in a tank with a thin layer of fine sand on the bottom. Water salinity was 36 ppt. The tank's water was changed daily, and the number of divided, undivided and dead animals were reported daily.

Discussion and conclusion

Observations showed that the body was more constricted at the constriction point. The posterior part was swollen and extended. The posterior and anterior parts rotated in opposite directions resulting in more constriction until both parts stretched (Fig. 1C) and finally split, although they were still connected to each other via the gut. After one day, the anterior and posterior parts were completely separated (Figs. 1D and 1E). The survival rate of the posterior part was higher than that of the anterior part. The entire process of fission lasted from one to five days.

Because of electrical problems that affected the water aeration, low survival rates were obtained.

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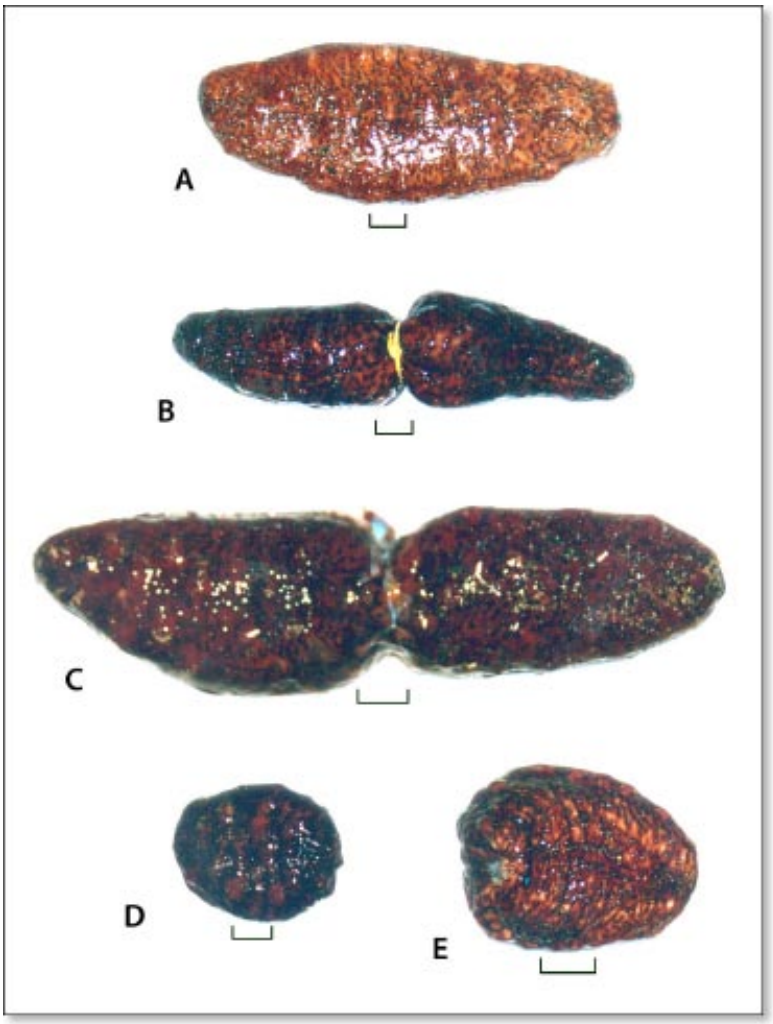

Figure 1. *Holothuria arenicola* induced fission.
A. Live animal before the rubber band is fitted.
B. the rubber band in place;
C. the anterior and posterior parts have stretched before splitting;
D. the anterior part after fission; and
E. the posterior part after fission.
Scale bars are all 1 cm.

Nevertheless, it was noted that individuals that eviscerated at the constriction point had a higher mortality rate than those individuals that kept their viscera. Additionally, temperature showed a considerable effect on the fission process. The dividing rate was greater at high temperatures (30°C) than at low temperatures (25°C). On the contrary, the survival rate of divided parts increased as water temperature decreased.

The wound-healing period lasted longer at high temperatures than at low temperatures. We concluded that the dividing rate increased with an increasing water temperature, while the survival rate of divided parts and the wound-healing period increased when the temperature decreased.

References

Kilada R.W., Abdel Razek F.A. and Yassin M.H. 2000. Population growth and sexual reproduction of the sea cucumber *Holothuria arenicola* from the Eastern Mediterranean Egypt. Journal of Aquatic Bulletin & Fisheries 4(4):119–135.

Shoukr F.A., Mona M.H. and Abdel–Hamid M.E. 1984. Holothurians (Echinodermata: Holothuroidea) from some Egyptian shores. Bulletin of the Faculty of Sciences of the Zagazig University 6:662–682.

Uthicke S. 2001. The process of asexual reproduction by transverse fission in *Stichopus chloronotus* (greenfish). SPC Beche-de-Mer Information Bulletin 14:23–25.