INTRODUCTION TO AQUATIC SCIENCES

8. Week	Live foods (microalgae, zooplankton and *Artemia*)

Introduction to Aquatic Sciences

WEEKLY TOPICS (CONTENT)

Week	Topics
1. Week	Aquaculture in Turkey and world
2. Week	The role of fish in human consumption
3. Week	What is fish? Taxonomy of fish
4. Week	Aquatic Crustacean
5. Week	Water quality for aquaculture
6. Week	Introduction to marine fish
7. Week	Introduction to freshwater fish
8. Week	Live foods (microalgae, zooplankton and *Artemia*)
9. Week	Introduction to fishing techniques
10. Week	Fish transport
11. Week	Introduction to fish disease
12. Week	Introduction to fisheries economy
13. Week	Processing and marketing of fish
14. Week	Introduction to fisheries and aquaculture management

CONTENTS

Lavens, P., & Sorgeloos, P. (1996). Manual on the production and use of live food for aquaculture (No. 361). Food and Agriculture Organization (FAO).

Phytoplankton comprises the base of the food chain in the marine environment. Therefore, micro-algae are indispensable in the commercial rearing of various species of marine animals as a food source for all growth stages of bivalve molluscs, larval stages of some crustacean species, and very early growth stages of some fish species. Algae are furthermore used to produce mass quantities of zooplankton (rotifers, copepods, brine shrimp) which serve in turn as food for larval and early-juvenile stages of crustaceans and fish (Fig. 2.1.). Besides, for rearing marine fish larvae according to the "green water technique"
algae are used directly in the larval tanks, where they are believed to play a role in stabilizing the water quality, nutrition of the larvae, and microbial control.

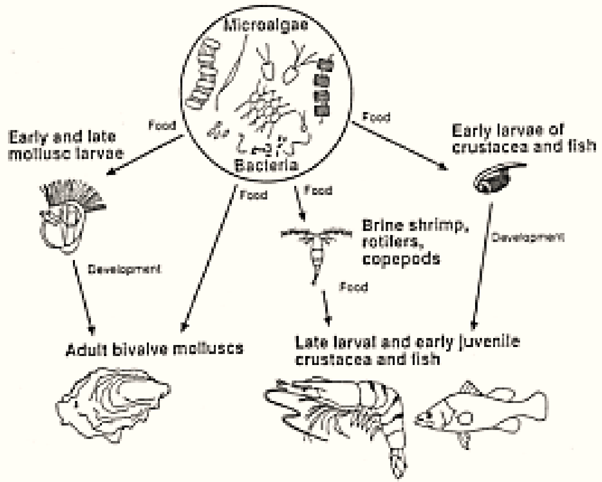

Figure 2.1. The central role of micro-algae in mariculture (Brown *et al.*, 1989).

Today, more than 40 different species of micro-algae, isolated in different parts of the world, are cultured as pure strains in intensive systems. Table 2.1. lists the eight major classes and 32 genera of cultured algae currently used to feed different groups of commercially important aquatic organisms. The list includes species of diatoms, flagellated and chlorococcalean green algae, and filamentous blue-green algae, ranging in size from a few micrometer to more than 100 µm. The most frequently used species in commercial mariculture operations are the diatoms *Skeletonema costatum*, *Thalassiosira pseudonana*, *Chaetoceros gracilis*, *C. calcitrans*, the flagellates *Isochrysis galbana*, *Tetraselmis suecica*, *Monochrysis lutheri* and the chlorococcalean *Chlorella* spp. (Fig. 2.2.).

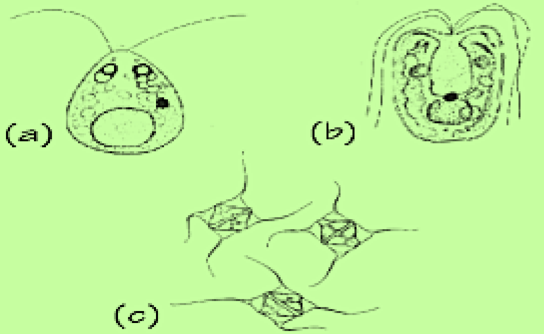

Figure 2.2. Some types of marine algae used as food in aquaculture (a) *Tetraselmis* spp. (b) *Dunaliella* spp. (c) *Chaetoceros* spp. (Laing, 1991).

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Table 2.1. Major classes and genera of micro-algae cultured in aquaculture (modified from De Pauw and Persoone, 1988) .

Class	Genus	Examples of application
Bacillariophyceae	*Skeletonema*	PL,BL,BP
	Thalassiosira	PL,BL,BP
	Phaeodactylum	PL,BL,BP,ML,BS
	Chaetoceros	PL,BL,BP,BS
	Cylindrotheca	PL
	Bellerochea	BP
	Actinocyclus	BP
	Nitzchia	BS
	Cyclotella	BS
Haptophyceae	*Isochrysis*	PL,BL,BP,ML,BS
	Pseudoisochrysis	BL,BP,ML
	dicrateria	BP
Chrysophyceae	*Monochrysis (Pavlova)*	BL,BP,BS,MR
Prasinophyceae	*Tetraselmis (Platymonas)*	PL,BL,BP,AL,BS,MR
	Pyramimonas	BL,BP
	Micromonas	BP
Cryptophyceae	*Chroomonas*	BP
	Cryptomonas	BP
	Rhodomonas	BL,BP
Cryptophyceae	*Chlamydomonas*	BL,BP,FZ,MR,BS
	Chlorococcum	BP
Xanthophyceae	*Olisthodiscus*	BP
Chlorophyceae	*Carteria*	BP
	Dunaliella	BP,BS,MR
Cyanophyceae	*Spirulina*	PL,BP,BS,MR

PL, penaeid shrimp larvae; BL, bivalve mollusc larvae; ML, freshwater prawn larvae; BP, bivalve mollusc postlarvae; AL, abalone larvae; MR, marine rotifers (*Brachionus*); BS, brine shrimp (*Artemia*); SC, saltwater copepods; FZ, freshwater zooplankton

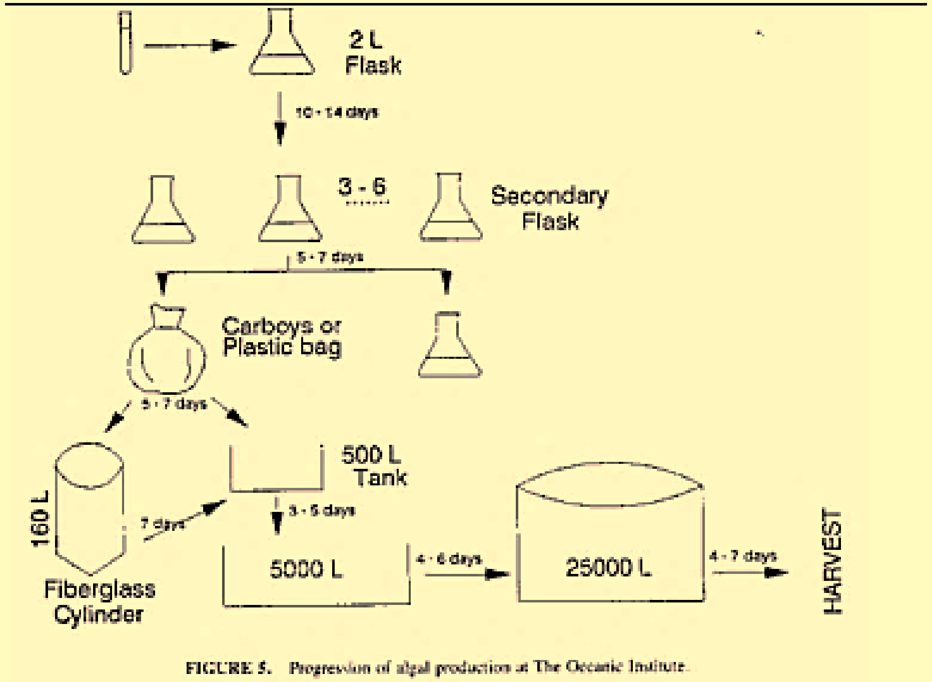

FIGURE 5. Progression of algal production at The Oceanic Institute.

Figure 2.6. Production scheme for batch culture of algae (Lee and Tamaru, 1993).

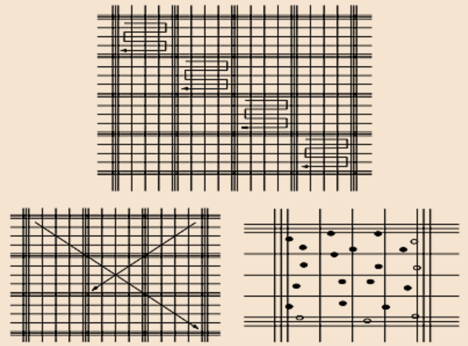

Figure 2.17. Counting directions (follow arrow) for Fuchs-Rosenthal chamber (upper diagram) and for Bürker (down left corner). For both, count the cells in the square and those which touch the top and left border (•). Do not count the ones touching the right and lower border (o) (see down right corner).

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Rotifers

Although *Brachionus plicatilis* was first identified as a pest in the pond culture of eels in the fifties and sixties, Japanese researchers soon realized that this rotifer could be used as a suitable live food organism for the early larval stages of marine fish. The successful use of rotifers in the commercial hatchery operations of the red sea bream (*Pagrus major*) encouraged investigations in the development of mass culture techniques of rotifers. Twenty five years after the first use of rotifers in larviculture feeding several culture techniques for the intensive production of rotifers are being applied worldwide. The availability of large quantities of this live food source has contributed to the successful hatchery production of more than 60 marine finfish species and 18 species of crustaceans. To our knowledge, wild

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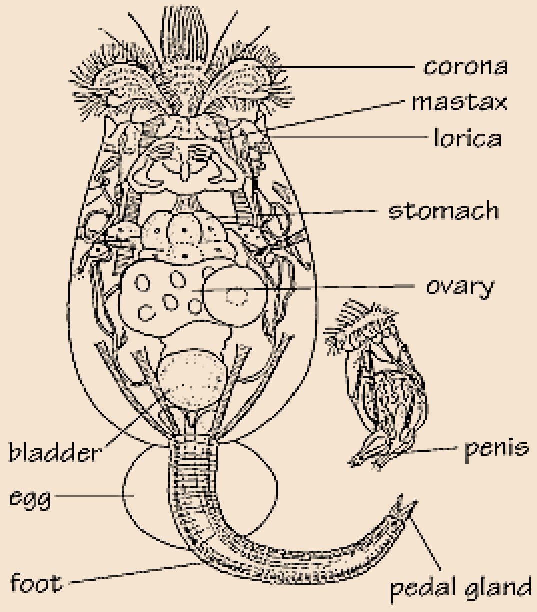

Figure 3.1. ***Brachionus plicatilis*, female and male (modified from Koste, 1980).**

3.3. Biology and life history

The life span of rotifers has been estimated to be between 3.4 to 4.4 days at 25° C. Generally, the larvae become adult after 0.5 to 1.5 days and females thereafter start to lay eggs approximately every four hours. It is believed that females can produce ten generations of offspring before they eventually die. The reproduction activity of *Brachionus* depends on the temperature of the environment as illustrated in Table 3.1.

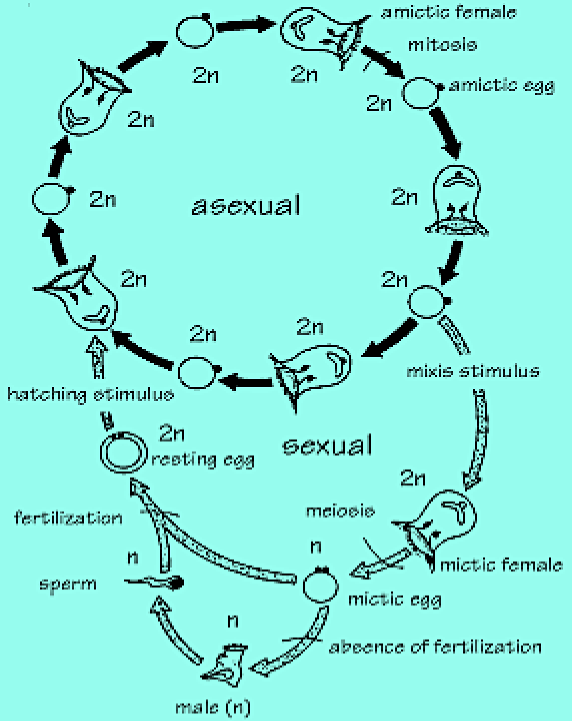

Figure 3.2. Parthenogenetical and sexual reproduction in *Brachionus plicatilis* (modified from Hoff and Snell, 1987).

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4. *ARTEMIA*

4.1. Introduction, biology and ecology of *Artemia*

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4.1.1. Introduction

Among the live diets used in the larviculture of fish and shellfish, nauplii of the brine shrimp *Artemia* constitute the most widely used food item. Annually, over 2000 metric tons of dry *Artemia* cysts are marketed worldwide for on-site hatching into 0.4 mm nauplii. Indeed, the unique property of the small branchiopod crustacean *Artemia* to form dormant embryos, so-called 'cysts', may account to a great extent to the designation of a convenient, suitable, or excellent larval food source that it has been credited with. Those cysts are available year-round in large quantities along the shorelines of hypersaline lakes, coastal lagoons and solar saltworks scattered over the five continents. After harvesting and processing, cysts are made available in cans as storable 'on demand' live feed. Upon some 24-h incubation in seawater,

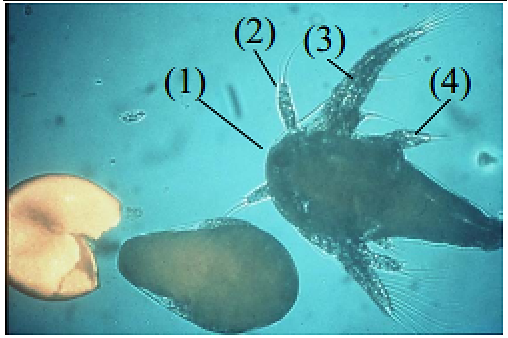

Figure 4.1.3. Embryo in "umbrella" stage (left) and instar I nauplius (right). (1) nauplius eye; (2) antennula; (3) antenna; (4) mandible.

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