

CAROTENOIDS IN AQUACULTURE. NEW ALTERNATIVE NATURAL SOURCES

INTRODUCTION AND OBJECTIVES

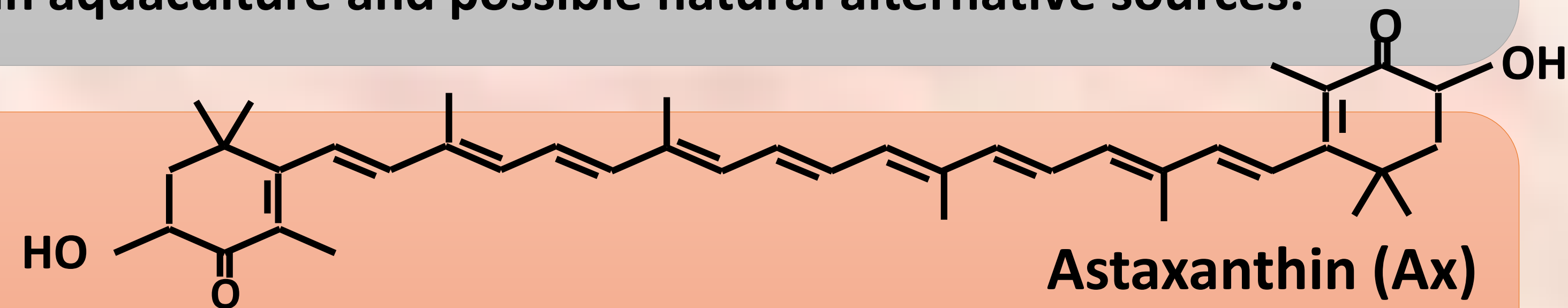
The pigments have an essential role in the salmonids quality giving flesh and skin coloration, highly valued by consumers. So far pigmentation is provided by synthetic sources, which offer better prices and yields. However in recent years, the consumers' desire for sustainable and environmentally responsible fish farming has led to increased use of natural ingredients in the feed. The aim of this projects is to provide an overview of the pigments in aquaculture and possible natural alternative sources.

PHYSICO-CHEMICAL PROPERTIES OF CAROTENOIDS

- ❖ Isoprene subunits linked by double bonds.
- ❖ 40 carbon atoms.
- ❖ Colours from yellow to red.
- ❖ Lipophilic

- ❖ Isomerization (E/Z)
- ❖ Free (F)/esterified (Es)/linked

- ❖ Carotenes or Xanthophylls



ANIMAL-RELATED FACTORS

- 🐟 Depends largely on the animal species
- 🧬 Individual variability
- +6 Lipids absorption/muscle density
- ♀ Male → Ax in the gonads
♂ Male → Ax in the skin
- ⊕ Feed consumption = ↓ Absorption + ↓ Pigmentation

ASTAXANTHIN FUNCTIONS IN AQUACULTURE

- Coloration (looks as wild animals)
- Provitamin A
- Antioxidant
- Sunlight protection
- Communication and relationship

INGESTION

DIGESTION

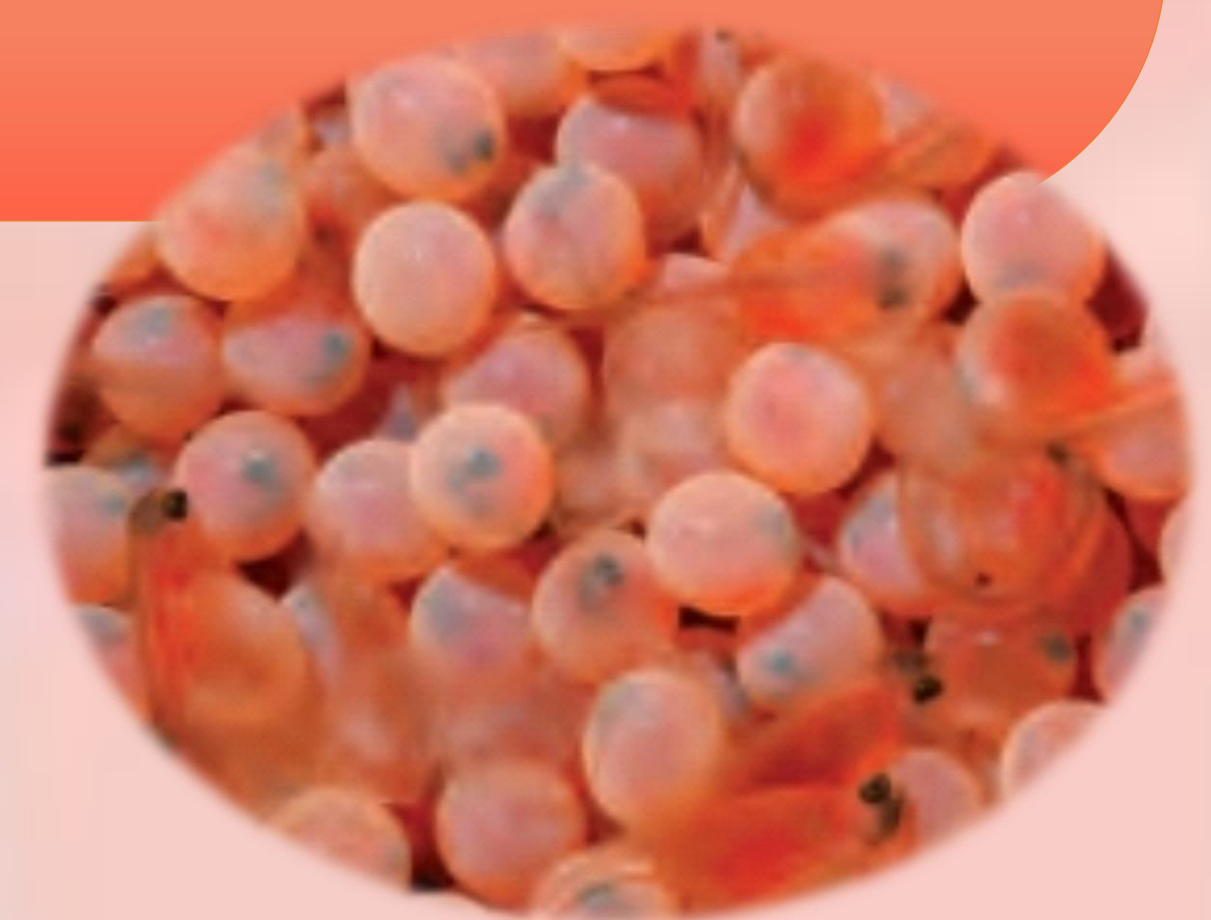
ABSORPTION (35 – 70%)

TRANSPORT Chylomicrons

DEPOSITION Muscle and skin (10 - 17%)

FEED-RELATED FACTORS

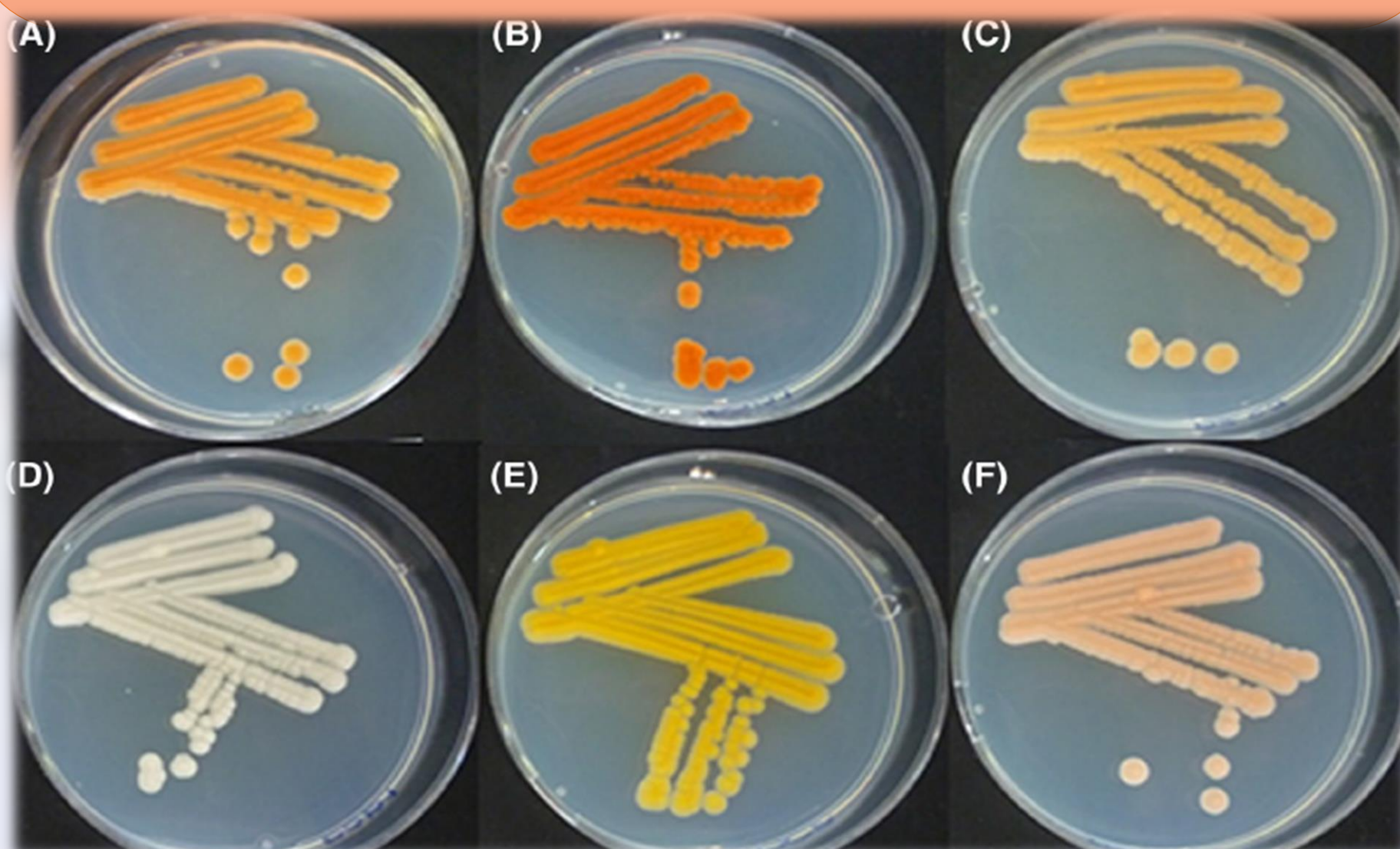
- ⬆ Kg ↑ Ax ingestion ↑ Ax deposition
- ⬆ Oxidative degradation
- ⬆ E161y ↑ Minerals/Antioxidants/VitaminE /Lipids
- ⬆ E/Z Head, oxidation or digestion
- ⬆ F/Es Absorbed/Deposited



NATURAL SOURCES

YEASTS

- ❖ *Phaffia rhodozyma*.
- ❖ Ax production (30-800mg Ax/kg DW).
- ❖ Chitin cell wall.
- ❖ Authorised additive by EFSA



Mutants of *X. dendrorhous* after treatment with *N*-methyl-*N*'nitro-*N*-nitrosoguanidine. A) wild type, b) read, c) pale orange, d) White, e) yellow and f) pink mutants. Font: Barbachano-Torres A, Castelblanco-Matiz LM, Ramos-Valdivia AC, Cerda-García-Rojas CM, Salgado LM, Flores-Ortiz CM, Ponce-Nyola L. Analysis of proteomic changes in colored mutants of *Xanthophyllomyces dendrorhous* (*Phaffia rhodozyma*). Arch Microbiol. 2014; 196: 411-422.

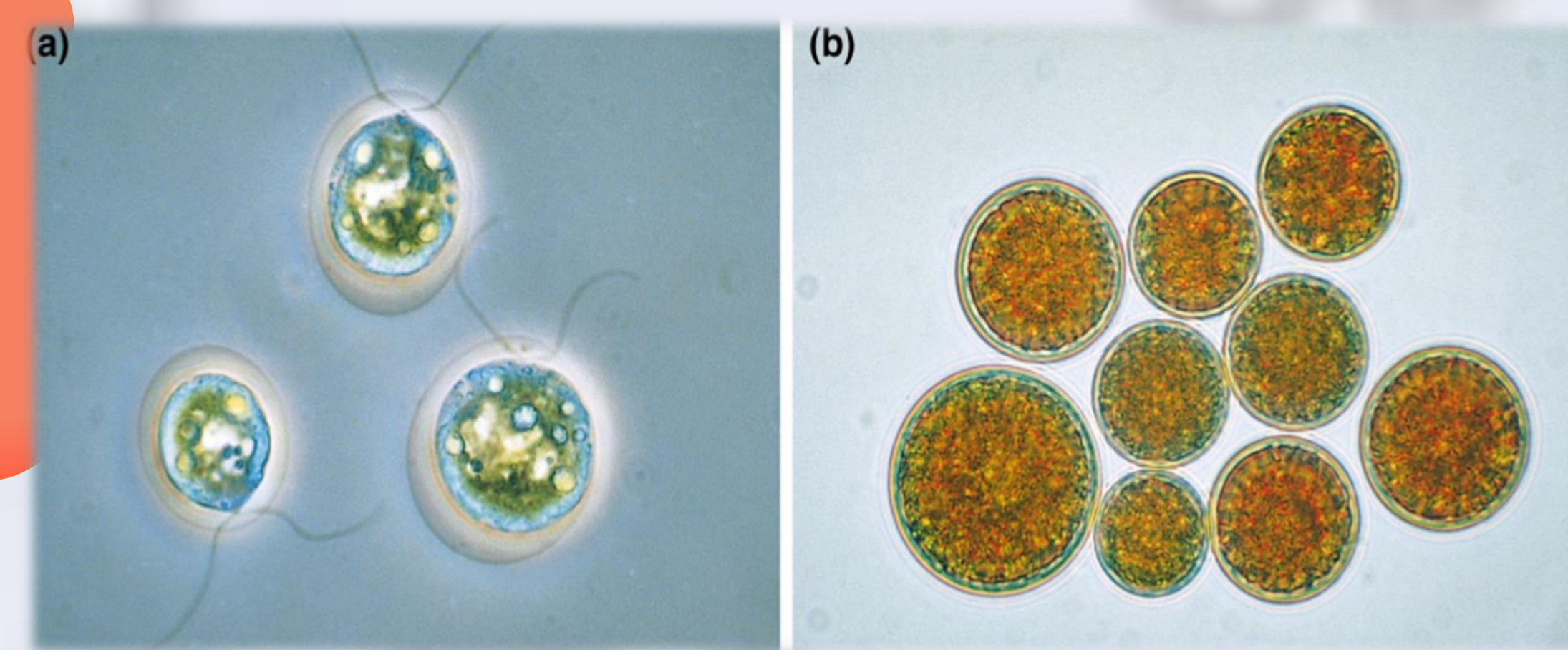
MICROALGAE

- ❖ *Haematococcus pluvialis*.
- ❖ 1-3% esterified Ax of DW.
- ❖ Cyst cell wall composed by algaenan.
- ❖ Unauthorised additive by EFSA.

- ❖ *Arthrospira platensis* or *Spirulina platensis*.
- ❖ Rich in nutrients and carotenoids.
- ❖ Cell wall composet by murein.
- ❖ Unauthorised additive by EFSA.

BACTERIA

- ❖ *Paracoccus carotinifaciens*.
- ❖ 2,2 % free Ax of DW.
- ❖ Other carotenoids (adonirubin and cantaxanthin).
- ❖ Authorised additive by EFSA.



Haematococcus pluvialis a) vegetative form b) cyst with Ax acumulation.

CONCLUSIONS

Carotenoids investigation begins with the start of the salmonids farming and the problem of depigmentation. In the beginning, the aim was to know what kind of carotenoids we found in the aquatic animals, their metabolism and how these could be synthesized. This carotenoid was Ax. In recent years, with the transformation of the market, companies have been forced to find natural alternative sources.

Understanding the absorption mechanism, determining the factors and deposition may enable manipulation of the process and greatly improve the amount of Ax that can be absorbed.

The future of natural alternative sources are microorganisms and the development of new strains, mutants, culture media and treatments with the aim to obtain higher yields and bioavailability.