THE EFFECT OF PHOTOPERIOD ON VITELLOGENIN SYNTHESIS AND OOCYTE ENDOCYTOSIS IN RAINBOW TROUT (*ONCORHYNCHUS MYKISS*)

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Introduction

Oocyte vitellogenesis is one of the best examples of cell specialization for specific endocytosis of proteins. Vitellogenin (VTG) a hepatically synthetized glycophospholipoprotein, the main plasma yolk precursor, is taken up selectively from blood and internalized into oocytes by a receptor-mediated mechanism.

Fish VTG receptors undergo seasonal fluctuations in both concentration and binding affinity during oocyte growth. This study deals with the influence of photoperiod on the binding characteristics of VTG to its specific receptors by comparing two groups of precocious winter rainbow trout (*Oncorhynchus mykiss)* reared at constant temperature in spring water on a spawner diet :

- group 1 (N) with a simulated natural photoperiod cycle of 12 months, spawning in early winter
- group 2 (S) with a cycle shortened by a daily reduction of the light from an initial 16h to 8h over a period of 7 months, resulting in summer spawning.

Material and methods

Ovaries were taken from freshly sacrificed rainbow trout of each of the two groups at the same stage of the reproductive cycle. This was during the rapid development phase when mean oocyte diameters were around 3.5 mm, in July for the S group and in September for the N group. Follicles from 6 fish per group were taken from the ovaries, separated and prepared following Le Menn and Nuñez Rodriguez (1990). Rainbow trout VTG was purified using one step DEAE Biogel ion-exchange chromatography, and iodinated using iodogen. Characterization of binding was performed by filter assay (Stifani *et al.*, 1990) with VTG specific activity not exceeding 100,000 cpm/pM.

Results

Changes in the gonadosomatic index (GSI) of S and N fish had a similar profile. After a postovulatory phase, the vitellogenesis of rainbow trout showed three successive gonad development phases: a very slow development (VSD), a slow development (SD) and a rapid development (RD). Compared with group N fish the only phase modified in the S group was the SD which was halved. The oocyte diameter in both N and S groups increased in direct proportion with the gonadosomatic index during the vitellogenic stages. However, at spawning, there was a significant decrease (p=0.005) in ovule size in the S group.

For both groups an increase in E2 levels appeared along with the VSD phase and peaked one-and-a-half months before spawning, with maximum values around 30% greater for S than for N. Similarly, in both groups, increasing VTG levels appeared along with the VSD phase and peaked two weeks before spawning with maximum values around 30% greater for S than for N.

Transformation of VTG binding data to Scatchard plots indicated for both groups a single class of binding site for VTG. In spite of photoperiod modifications, VTG receptors remained saturable with N receptor preparations saturable faster than those of S. Binding data per 100 mm^2 of oocyte surface indicated in the S group a significant decrease (p=0.002) of over 2.4 fold in the affinity (Ka) and a significant increase (p=0.005) of over 2.1 fold in the number of binding sites (Bmax) (Fig.1) The consequence on the average ovule diameter was a significant decrease (p=0,005) in ovule size in the S group.

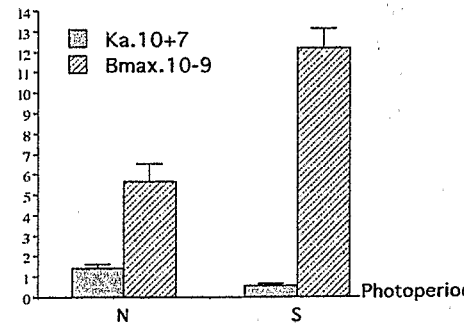

Fig.1 : VTG-receptors binding chatacteristics

Conclusion

The characteristics of VTG binding to its specific membrane receptors are clearly photoperiod dependent during the oocyte rapid growth phase. Shortening the reproductive cycle in rainbow trout over a period of 7 months induces a modification of the capacity of oocyte receptors for their specific binding with VTG, leading to a decrease in the amount of yolk sequestrated and thus in the size of spawned ovules.

References

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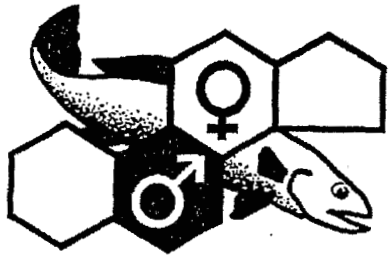

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