MORPHOFUNCTIONAL CORRELATIONS IN BROWN TROUT (*Salmo trutta*) KIDNEY PEROXISOMES

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INTRODUCTION

Hepatic peroxisomes of female brown trout presented morphological and biochemical changes during the breeding cycle.

The variations suggests a sex steroid modulation of peroxisomes in liver [1].

Are peroxisomes from other organs also modulated by sex hormones?

Aim

To investigate seasonal and gender alterations in kidney peroxisomes morphology and biochemistry, analysing possible correlations with the gonadal maturation level.

METHODOLOGY

Quantitative morphology at TEM level, using cytochemical detection of catalase with DAB to stain peroxisomes.

Stereological and biochemical analyses of renal peroxisomes from males and females in four seasons of their reproductive cycle.

Spectrophotometric measurements of peroxisomal enzymatic activities.

Breeding Cycle of Brown Trout

PRE-SPAWNING DECEMBER

END OF SPAWNING FEBRUARY

PRE-VITELLOGENESIS MAY

VITELLOGENESIS SEPTEMBER

RESULTS

Proximal Tubule I						
Parameters	S_v (P, Cell I) (µm²/ µm³)		V_v (P, Cell I) (%)		N_v (P, Cell I) (no. / µm³)	
Sex	♀	♂	♀	♂	♀	♂
February	0.05 (0.15)	0.05 (0.19)	0.68 (0.19)	0.54 (0.17)	0.06 (0.13)	0.08 (0.38)
May	0.07 (0.40)	0.06 (0.15)	0.72 (0.37)	0.59 (0.15)	0.10 (0.23)	0.06 (0.17)
September	0.08 (0.28)	0.05 (0.21)	0.68 (0.25)	0.58 (0.27)	0.06 (0.13)	0.08 (0.24)
December	0.06 (0.17)	0.04 (0.41)	0.60 (0.20)	0.52 (0.48)	0.09 (0.34)	0.06 (0.50)

Proximal Tubule II						
Parameters	S_v (P, Cell II) (µm²/ µm³)		V_v (P, Cell II) (%)		N_v (P, Cell II) (no. / µm³)	
Sex	♀	♂	♀	♂	♀	♂
February	0.07 (0.18) ^{Aa}	0.02 (0.69) ^{Ba}	0.80 (0.18) ^{A}	0.34 (0.74) ^{Ba,c}	0.12 (0.17) ^{Aa}	0.02 (0.71) ^{Ba}
May	0.12 (0.10) ^{Ab}	0.08 (0.33) ^{Bb}	1.11 (0.12)	0.83 (0.37) ^{b,c}	0.24 (0.27) ^{Ab}	0.14 (0.41) ^{Bb}
September	0.09 (0.27) ^{a}	0.06 (0.36) ^{b}	0.91 (0.28)	0.57 (0.33) ^{c}	0.13 (0.19) ^{a}	0.09 (0.50)
December	0.09 (0.21) ^{Aa}	0.02 (0.71) ^{Ba}	0.88 (0.25) ^{A}	0.18 (0.72) ^{Ba}	0.22 (0.25) ^{Ab}	0.04 (0.98) ^{Ba}

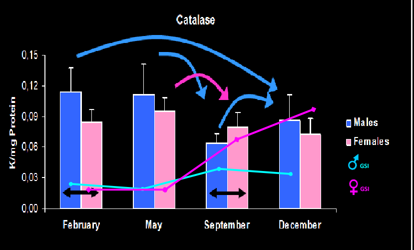
Proximal Tubule I						
Parameters	d (µm)		S (µm²)		v (µm³)	
Sex	♀	♂	♀	♂	♀	♂
February	0.31 (0.16) ^{a}	0.24 (0.33)	0.90 (0.09)	0.79 (0.23)	0.12 (0.16) ^{a}	0.09 (0.33)
May	0.19 (0.24) ^{b}	0.20 (0.18)	0.67 (0.22)	0.75 (0.13)	0.07 (0.24) ^{b}	0.08 (0.14)
September	0.22 (0.20)	0.28 (0.21)	0.77 (0.21)	0.91 (0.15)	0.08 (0.20)	0.10 (0.21)
December	0.19 (0.37) ^{b}	0.22 (0.22)	0.67 (0.28)	0.72 (0.29)	0.07 (0.37) ^{b}	0.08 (0.22)

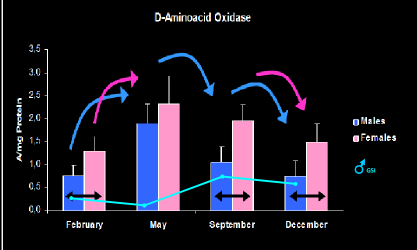
Proximal Tubule II						
Parameters	d (µm)		S (µm²)		v (µm³)	
Sex	♀	♂	♀	♂	♀	♂
February	0.17 (0.05) ^{Aa}	0.38 (0.33) ^{Ba}	0.58 (0.03) ^{a}	1.08 (0.44)	0.07 (0.05) ^{Aa}	0.15 (0.33) ^{Ba}
May	0.12 (0.22) ^{b}	0.16 (0.22) ^{b}	0.50 (0.23)	0.60 (0.20)	0.05 (0.22) ^{b}	0.06 (0.22) ^{b}
September	0.17 (0.10) ^{a}	0.20 (0.41) ^{b}	0.63 (0.08) ^{a}	0.72 (0.33)	0.07 (0.10) ^{a}	0.08 (0.41) ^{b}
December	0.11 (0.29) ^{b}	0.19 (0.68) ^{b}	0.41 (0.25) ^{b}	0.74 (0.61)	0.04 (0.29) ^{b}	0.07 (0.65) ^{b}

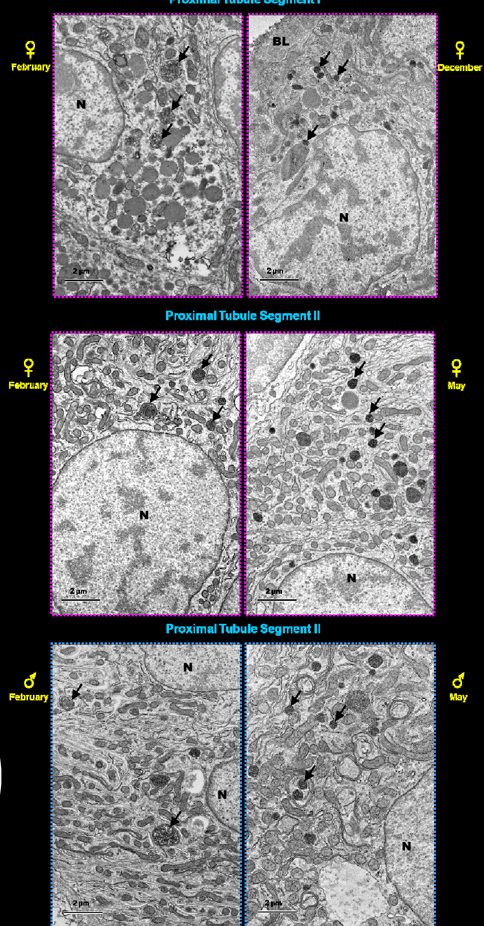
Surface density (S_v), volume density (V_v), numerical density (N_v), spherical-equivalent diameter (d), surface (s), volume (v). P – peroxisome, Cell – proximal tubule cell. Results are shown as mean (CV). CV is the coefficient of variation (CV = standard deviation/mean). Different upper case superscript letters represent differences between genders within each month; different lower case superscript letters represent differences among months within a gender; the presence of the same letter means absence of differences.

Statistical analysis by two-way ANOVA, with Tukey and Newman-Keuls post-hoc tests. Differences considered significant for $p \leq 0,05$.

Gonado-somatic index (GSI = (gonad weight × 100) ÷ body weight). Differences among months are represented by arrows, males (blue) and females (pink); differences between genders within each month by black arrows. Vertical bar = standard deviation. Urate oxidase and L-α hydroxy acid oxidases A and B activities were not detected in renal homogenates. Palmitoyl CoA oxidase activity did not show any significant difference.







TEM images of female (♀) and male (♂) brown trout kidney tubules, with peroxisomes evidenced by DAB staining for catalase (arrows). N – nucleus, BL – basal lamina.

Renal peroxisomes suffer morphological variations along the year and between genders, particularly those from proximal tubule II where they are more numerous.

The morphological changes were not correlated with the GSI, suggesting that renal peroxisomes morphology is not modulated by gonad maturation level and consequently by sex steroid hormones.

Biochemical variations in renal peroxisomes also occurred along the year. Catalase activity pattern was negatively correlated with GSI in both genders, contrary to what happens in liver. Kidney peroxisomal physiology seems to be influenced by gonad status.

Correlations between D-alanine oxidase activities and the total peroxisome number and volume per g of kidney were found in both genders.

↑ Peroxisome Number = ↑ Volume per g kidney = ↑ D-alanine oxidase activities

References [1] Rocha, E., Lobo-da-Cunha, A., Monteiro, R. A. F., Silva, M. W. and Oliveira, M. H. (1999). *Journal of Submicros. Cytol. and Pathol.* **31**, 91-105.

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