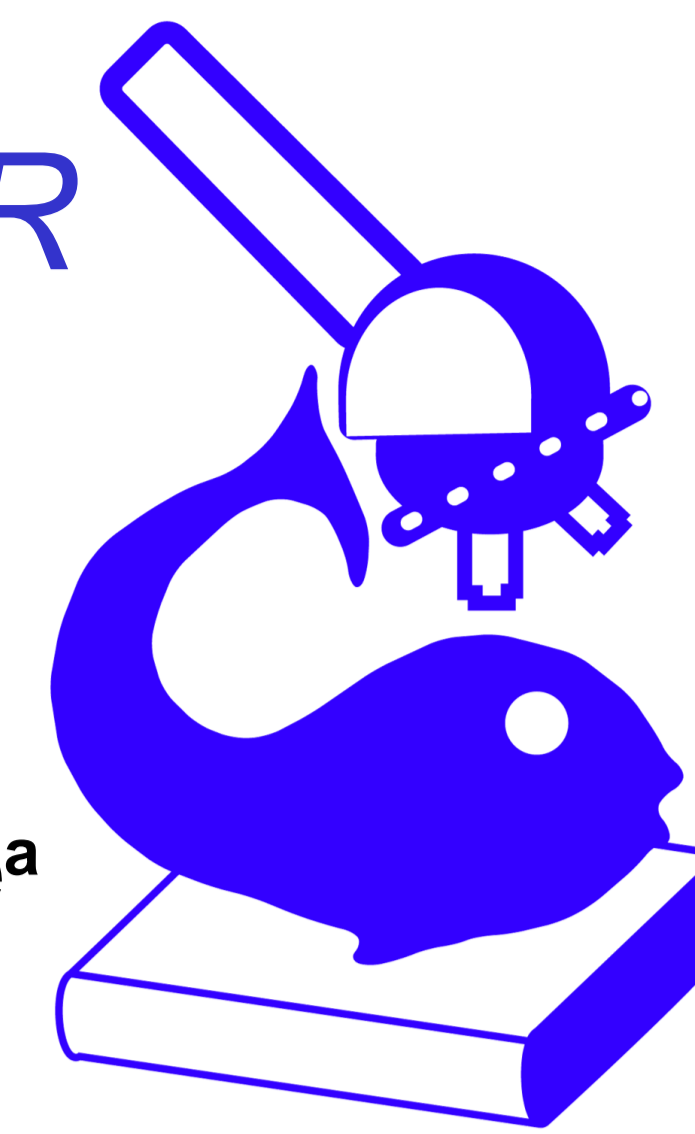


GILL INTEGRITY OF JUVENILE PIKE PERCH (*SANDER LUCIOPERCA*) UNDER SALINE CONDITIONS IN RECIRCULATING AQUACULTURE SYSTEM



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Introduction

Changes in the ion composition of the water directly affect fish. To maintain an inner homeostasis at fluctuating environmental conditions, fish osmoregulate (Ložys, 2004; Greenwell et al., 2003). Recent studies indicate that already slight changes of the ion water composition affect the overall fish gill integrity (Baberschke et al., 2019). In freshwater fish, the gill is the primary osmoregulatory organ. In particular, gill related chloride cells are responsible for balancing the ion budget in order to maintain homeostasis (Greenwell et al., 2003). The study was aimed to evaluate the effects of salinity on the gill integrity of juvenile pike perch in recirculating aquaculture system (RAS).

Materials and Methods

In a 78 days trial, juvenile pike perch (31±5 g) were reared in five identical RAS with a volume of 1 m³. Each RAS was compiled of three rearing tanks and a mechanical/biological water treatment unit. In total, five different salinity regimes (0, 3, 6, 9, 12 PSU) were tested. Salinity was added as NaCl with purity of 99.8% (ESCO).

On day 1, 3, 8, 36, and 78 of the experiment, the second raker of the right gill (n=6 per treatment) was taken for histological analyses. After preparation, samples were hematoxylin-eosin stained and analyzed at a magnification of 400x under a light microscope (Leitz Laborlux S, Germany). Per gill, three neighbouring primary filaments and 20 secondary filaments per primary filament (10 ventral + 10 dorsal) were observed for: number of chloride/mucous cells, fusion of the lamella, hypertrophy of chloride cells, epithelial lifting as well as hyperplasia of the inter lamella room (Figure 1 A-D).

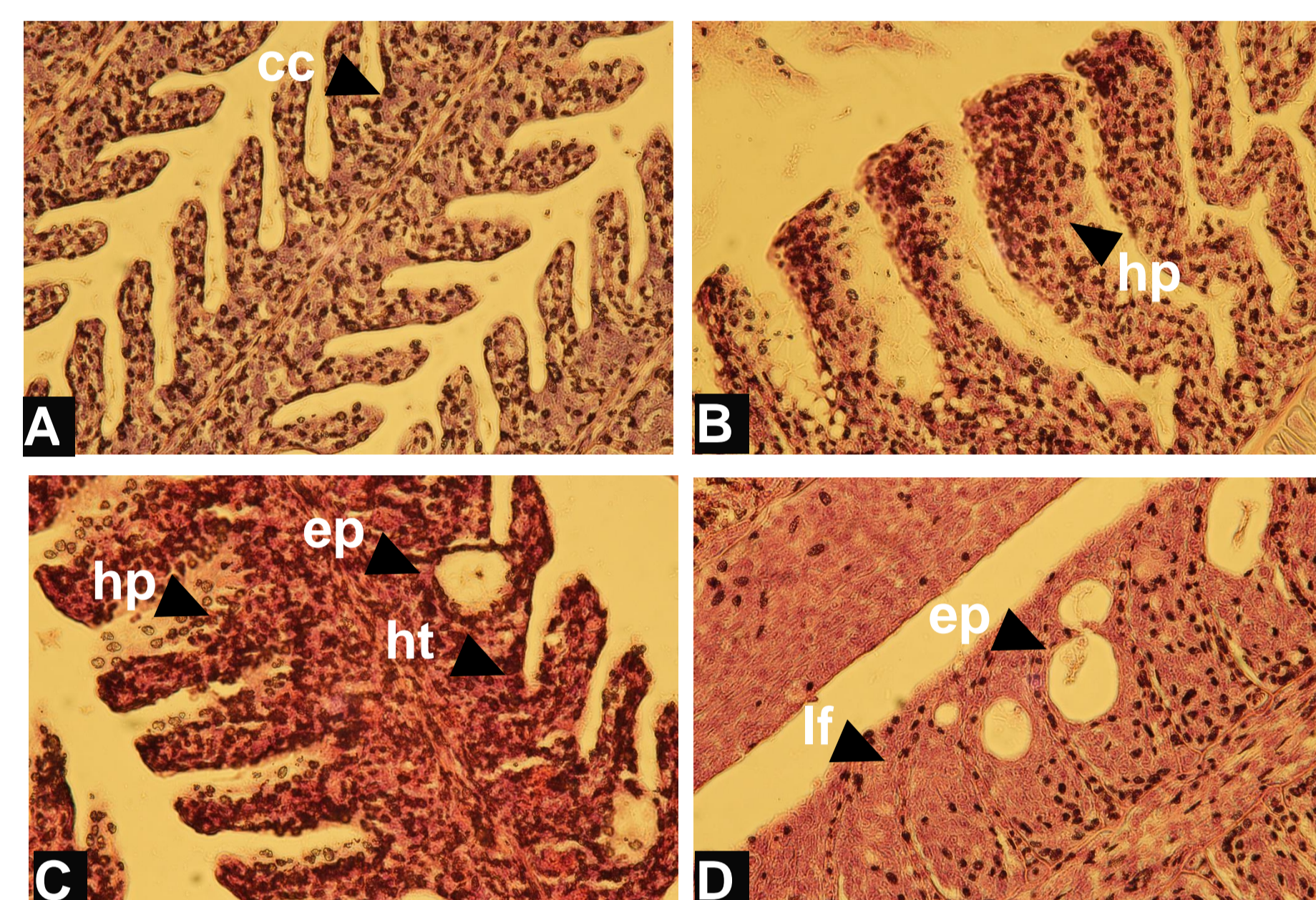


Figure 1. (A) 0 PSU, An unaltered gill filaments with chloride cells (cc), (B) 3 PSU, (C) 6 PSU, and (D) 9 PSU, filaments with histopathological alterations: hyperplasia of lamellae (hp), epithelial lifting (ep), hypertrophy of chloride cell (ht), and lamellae fusion (lf), at magnification of 400x.

Results and Discussion

The application of NaCl to the rearing environment of originally freshwater adapted pike perch, had effects on the number of the chloride and mucous cells. It was found that the number of chloride and mucous cells increased with the increasing salinity treatment (Figure 2). The higher number of chloride cells of treatment groups than the control probably can be explained as the gill morphological adaptation process in order to facilitate the transportation of excess monovalent ions Na⁺ and Cl⁻ to maintain ion homeostasis (Greenwell et al., 2003).

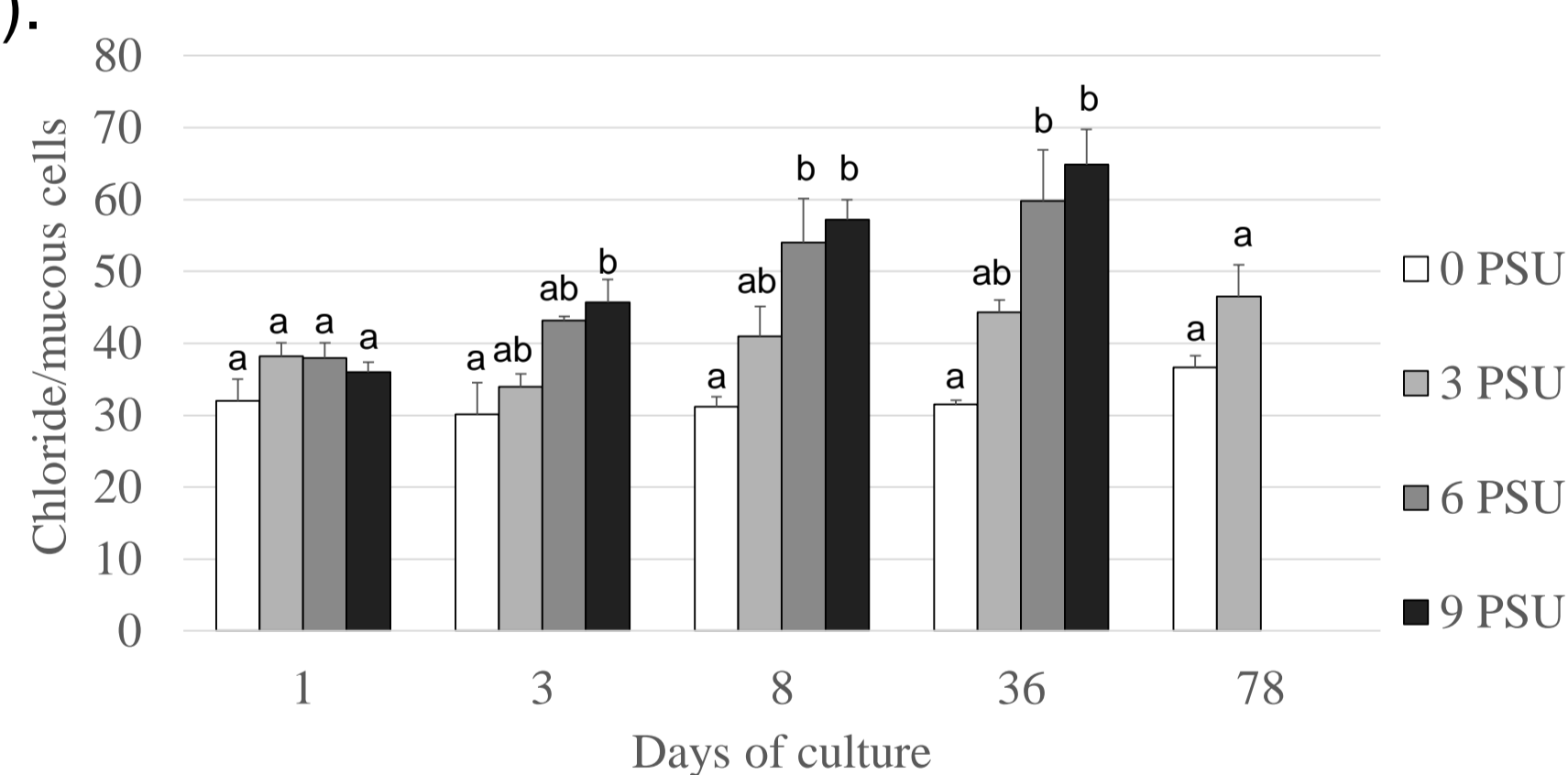


Figure 2. Number of chloride/mucous cells ± SE.

Based on the experiment, all control and treatment groups finished with similar and close to 100% survival rate. The treatment groups of 6 PSU and 9 PSU showed signs of growth depression at day 36, which was the reason to terminate the experiment for these groups. The treatment groups responded differently to the variety of NaCl concentration. Generally, the higher number of histopathological alterations can be observed in the higher concentration of NaCl salt. The 9 PSU treatment had the highest mean of hyperplasia, fusion of the lamellae, epithelial lifting, and hypertrophy (Figure 3 A-D).

In conclusion, the increase of environmental salinity directly affects the gill integrity of juvenile pike perch in RAS and the histopathological alterations generally indicate the vulnerability of the investigated gills. In addition to the lack of the growth of the fish in 6 and 9 PSU and the intolerance to 12 PSU (data not shown), we recommend - from the gill perspective - not to expose juvenile pike perch in RAS with salinities higher than 3 PSU.

References:

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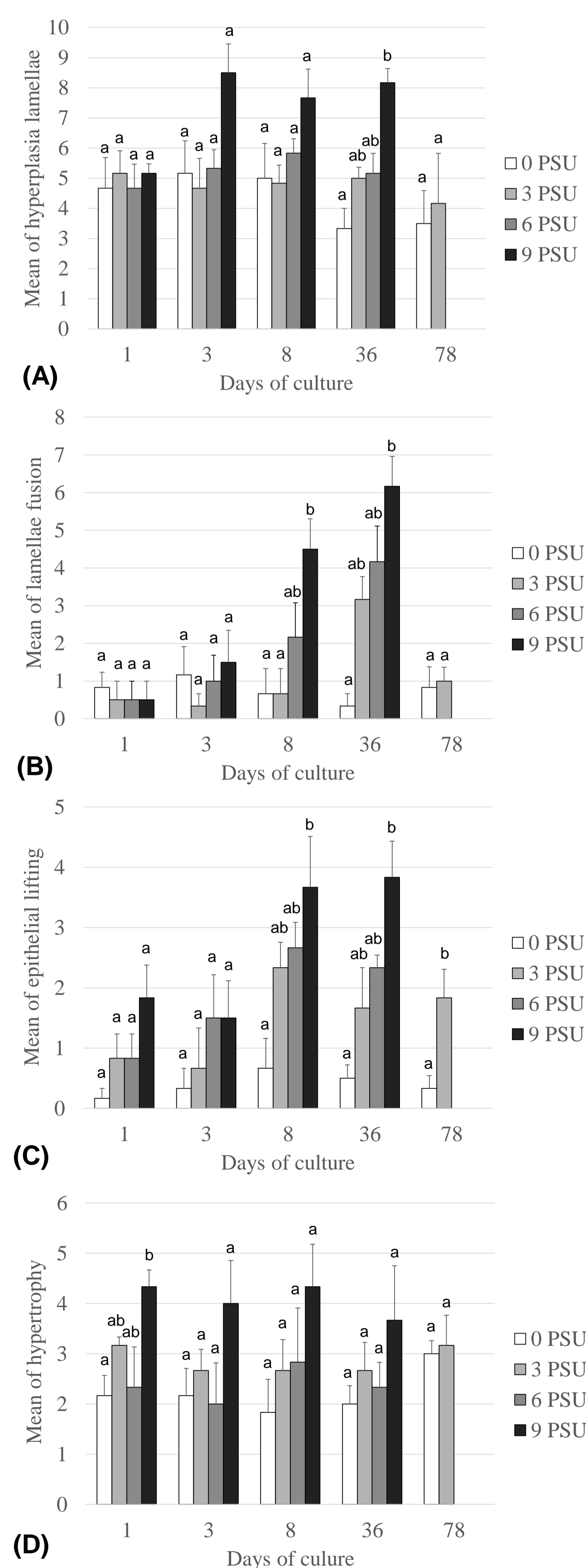


Figure 3. Mean number of altered lamellae ± SE: (A) hyperplasia, (B) lamellae fusion, (C) epithelial lifting, and (D) hypertrophy.