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Harvest quality of coho salmon raised in SEA System™ floating bag

The SEA System™ bag was developed by Future SEA Technologies Inc. to create a controlled environment for aquaculture. The flexible round enclosure is supplied with pumped water that can be drawn from optimum locations to regulate temperature, salinity and overall quality. The use of a pump also permits regulation of current speed. An evaluation of the bag technology in comparison with traditional netpen methods was conducted with coho salmon in 1997 at the Department of Fisheries and Oceans' Experimental Mariculture Facility, Nanaimo, BC. Growth performance data from this comparison were reported in Aquaculture Update #79. This report provides additional data on stress indicators and fish quality collected during the test.

Blood samples were collected at each growth sampling. Mean levels of plasma glucose and cortisol did not differ between the two systems at any time (Table 1).

Table 1. Stress indicators in coho plasma during grow out (overall mean, range of means).

	Bag	Netpen	
Glucose (mg/dl)	99.7 (97.8 - 102.1)	99.2 (91.5 - 109.9)	NSD
Cortisol (ng/ml)	318.7 (277.8 - 439.1)	322.7 (237.9 - 471.3)	NSD

Plasma lactate levels rose steadily during the trial, coho in the bag consistently showing higher levels than those in the netpen, although within ranges reported for other salmonids under exercise conditions (Figure 1). These data are not considered to represent normal values in the

two culture technologies, because they include the response of the fish to the sampling procedure. However, they may reflect characteristics of the response to stress in general, which has been noted to vary with level of swimming exercise in several salmonid species. Video camera observations revealed that average swimming speeds of coho in the bag were greater than those in the netpen.

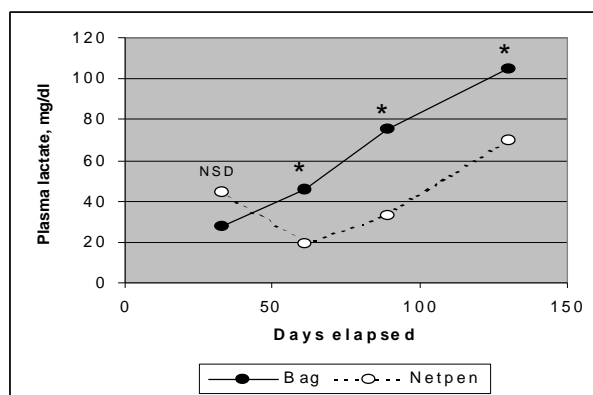


Figure 1. Plasma lactate in coho during grow out, March - July 1997.

Fin erosion measured at harvest (fin-length proportional to body-length averaged for dorsal, pectoral and pelvic fins) did not differ between the bag and the netpen despite the higher stocking density in the bag (24.1 kg/m³ versus 5 kg/m³). Fin erosion (loss of area) has been shown to increase in some fish species with increased stocking density, and can have consequences to swimming ability and market grading. Mucous cell counts sampled at a point on the fishes' skin between the dorsal fin and the lateral line showed that coho from the bag had more of these cells (Table 2).

Table 2. External characteristics of coho at harvest.

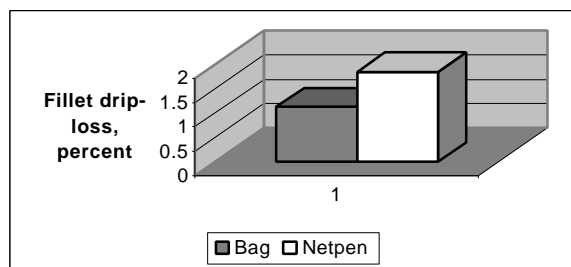
	Bag	Netpen	
Mean fin length relative to body length	1.3 %	1.3 %	NSD
Mucous cells/0.25 mm skin	14.1	3.3	**

Mucous-producing cells in the skin of fish can become more abundant with increased level of swimming, which might have advantages in defense against external fish pathogens.

Accumulation of solid lipid on the viscera of cultured fish may indicate diet utilization difficulties and is a revenue loss if discarded before final marketing. Drip-loss of water and soluble organic matter from fillets is likewise a financial loss, and has been noted in unfrozen products of capture fisheries. Visceral fat abundance, assessed with a subjective visual rating (1, 2 or 3), did not differ significantly

Table 3. Gross internal characteristics of coho at harvest.

	Bag	Netpen	
Visceral fat index	1.84	1.6	NSD
Fillet drip loss	1.12 %	1.84%	**

**Figure 2. Drip loss in coho fillets.**

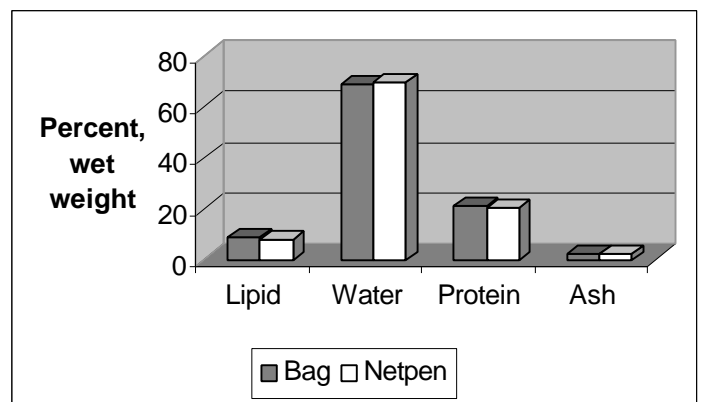
between bag and netpen coho, although more bag fish had higher amounts of visceral fat. In this study, drip loss measured from fillets after 48 hours refrigerated storage differed significantly,

with bag coho losing less weight in storage than netpen coho (Table 3, Figure 2). Netpen coho were estimated to have lost 30-40 grams more wet weight per fish from drip loss than did those in the bag.

Flesh colour due to content of carotenoid pigments is an important factor in consumer preferences in farmed salmon. Proximate composition, the relative amounts of lipid, water, protein and ash (inorganic matter) contained in a fish can be informative as to the nutritional status of the fish during its grow out, and will also influence its market characteristics and taste quality. There was no difference in carotenoid content or in any other components in samples of muscle between the bag coho and the netpen coho (Table 4, Figure 3). Both groups were fed the same commercial diet.

Table 4. Composition of coho fillets.

	Bag	Netpen	
Total carotenoid, micrograms/g (wet)	17.58	15.75	NSD
Lipid	8.54%	8.09 %	NSD
Water	69.03 %	69.57 %	NSD
Protein	20.79 %	20.56%	NSD
Ash	2.28 %	2.27 %	NSD

**Figure 3. Proximate composition of coho fillets.**

Consumption of omega-3 fatty acids found in lipids of marine fish is beneficial for human health. Coho were analyzed for presence of two main omega-3 fatty acids (eicosapentaenoic and docosahexaenoic acid). Results suggested that levels of both fatty acids were greater in coho fillets from the bag, however it was evident that within-sample variability was unusually high in both groups, preventing a final conclusion.

The table quality of coho harvested from the bag and the netpen was assessed at the University of British Columbia's Food Science Department. Trained panels of tasters evaluated plain cooked samples from frozen fillets in several sittings using a multiple comparisons procedure (Larmond 1977). The tasters did not detect any difference between coho from the bag and netpen in terms of aroma, flavor or tenderness (texture). The test did not include samples of commercially farmed coho salmon. Coho harvested from the bag system were processed commercially, and received favorable comments for flesh firmness, and minimal scale loss and low incidence of down-grade fish relative to normal farm-raised coho handled by that processor. On a research sample of 25 fish, dressing loss was 10.4 ± 2.2 percent in netpen fish and 12.5 ± 8.6 percent in

bag fish (mean, standard deviation), which was not a statistically significant difference.

General note: statistically significant differences are indicated in tables and charts by presence of asterisks, '' for 95 percent probability, '**' for 99 percent, or 'NSD' for no significant difference at the 95 percent confidence level.*

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