

## (*Huso huso*)

\*

$\frac{1}{g \pm 1} (H. huso) \times$   
%  
/ / / /  
( $p \geq /$ ) %  
( $p \leq /$ ) ( $/$ )  
( $p \leq /$ ) ( $/$ ) ( $/$ )  
/ ( $p \leq /$ )  
% % %  
/ g  
:  
(IUCN)  
.[ ]

[ ]

[ ]

[ ]

[ ]

[ ]

[ ]

[ ]

[ ]

[ ]

( )

[ ] (*A. transmontanus*)

// //

(*Ictalurus punctatus*)

cm )

g

(*Acipenser baeri*)

( L

cm

[ ]

( )  
% ( )  
/ / / / ×

mm CPM  
°C )

/ ± /

.(

.[ ]

( )

AOAC ( )

°C

°C

.[ ]

(N= / )

)

°C

(

°C

/

/

)

.[ ]

/

(

)

.[ ]

°C

(as fed )

(mj/kg)	(%)	(%)	(%)	(%)	(%)	( : )
/	/	/	/	/	/	(% : /)
/	/	/	/	/	/	(% : /)
/	/	/	/	/	/	(% : /)
/	/	/	/	/	/	(% : /)
/	/	/	/	/	/	(% : /)
/	/	/	/	/	/	(% : /)
/	/	/	/	/	/	(% : /)
/	/	/	/	/	/	(% : /)

$$(FCR) = \frac{\text{[ ]}}{\text{[ ]}}$$

$$(FE) = \frac{\text{[ ]}}{\text{[ ]}} \times \text{[ ]} \quad (\text{SGR \%day})$$

$$(K) = \frac{\text{[ ]}}{\text{[ ]}} \times \text{[ ]} \quad (\text{K}) \quad (\text{FCR})$$

$$(DFC) = \frac{\text{[ ]}}{\text{[ ]}} \times \text{[ ]} \quad (\text{PER}) \quad (\text{FE})$$

$$\text{[ ]} \quad (\text{NPU}) \quad (\text{DFC})$$

$$\text{[ ]} \quad (\text{HIS})$$

$$(PER) = \frac{\text{(g)}}{\text{(g)}}$$

$$(HSI) = \frac{\text{(g)}}{\text{(g)}} \times \text{[ ]}$$

$$\text{(cm)} = \frac{\text{[ ]}}{\text{[ ]}}$$

$$\text{(S.G.R.)} = \frac{\text{[ ]}}{\text{[ ]}} \times \text{[ ]}$$

- 2. Food Conversion Ratio
- 3. Food Efficiency
- 4. Condition Factor
- 5. Daily Food Conservation
- 6. Protein Efficiency Ratio
- 7. Hepatosomatic Index
- 8. Net Protein Utilization

- 1. Specific growth rate

/ SAS  
 pH / mg/L / / °C  
 / /  
 %  
 (NPU)  
 (pH )

( )		(%)			( )	(g)	
± / a	/ ± / bc	/ ± / ab	/ ± / ab	/ ± / ab	/ ± / a	/ ± / ab	( - / )
± / a	/ ± / a	/ ± / a	/ ± / b	/ ± / ab	/ ± / a	/ ± / a	( - / )
± / a	/ ± / bc	/ ± / ab	/ ± / ab	/ ± / ab	/ ± / a	/ ± / ab	( - / )
± / a	/ ± / abc	/ ± / ab	/ ± / ab	/ ± / ab	/ ± / a	/ ± / ab	( - / )
± / a	/ ± / bc	/ ± / ab	/ ± / ab	/ ± / ab	/ ± / a	/ ± / ab	( - / )
± / a	/ ± / ab	/ ± / ab	/ ± / ab	/ ± / a	/ ± / a	/ ± / a	( - / )
± / b	/ ± / c	/ ± / b	/ ± / a	/ ± / b	/ ± / a	/ ± / b	( - / )
± / ab	/ ± / ab	/ ± / ab	/ ± / ab	/ ± / ab	/ ± / a	/ ± / ab	( - / )
/	/	/	/	/	/	/	
/	/	/	/	/	/	/	
/	/	/	/	/	/	/	

(p < / )

	(%)	%	%	%	%	
/ ± / <sup>a</sup>	/ ± / <sup>bc</sup>	/ ± / <sup>ab</sup>	/ ± / <sup>cd</sup>	/ ± / <sup>b</sup>	/ ± / <sup>ab</sup>	( - / )
/ ± / <sup>b</sup>	/ ± / <sup>ef</sup>	/ ± / <sup>c</sup>	/ ± / <sup>bc</sup>	/ ± / <sup>cd</sup>	/ ± / <sup>a</sup>	( - / )
/ ± / <sup>b</sup>	/ ± / <sup>a</sup>	/ ± / <sup>bc</sup>	/ ± / <sup>d</sup>	/ ± / <sup>a</sup>	/ ± / <sup>b</sup>	( - / )
/ ± / <sup>b</sup>	/ ± / <sup>g</sup>	/ ± / <sup>bc</sup>	/ ± / <sup>d</sup>	/ ± / <sup>d</sup>	/ ± / <sup>a</sup>	( - / )
/ ± / <sup>b</sup>	/ ± / <sup>cd</sup>	/ ± / <sup>ab</sup>	/ ± / <sup>d</sup>	/ ± / <sup>b</sup>	/ ± / <sup>a</sup>	( - / )
/ ± / <sup>b</sup>	/ ± / <sup>fg</sup>	/ ± / <sup>ab</sup>	/ ± / <sup>ab</sup>	/ ± / <sup>d</sup>	/ ± / <sup>c</sup>	( - / )
/ ± / <sup>b</sup>	/ ± / <sup>de</sup>	/ ± / <sup>a</sup>	/ ± / <sup>a</sup>	/ ± / <sup>bc</sup>	/ ± / <sup>c</sup>	( - / )
/ ± / <sup>b</sup>	/ ± / <sup>b</sup>	/ ± / <sup>ab</sup>	/ ± / <sup>ab</sup>	/ ± / <sup>b</sup>	/ ± / <sup>c</sup>	( - / )
/		/	/		/	
/	/	/	/	/	/	
/		/	/	/	/	

(p < / )

( / / ) %

) ( )

(

(p ≤ / ) / %

(NPU) %

/ /

: /

(p ≤ / ) (p ≤ / ) NPU

( ) /

( ) /

: /

(p ≤ / )

(p ≤ / )

(% : / )  
(P≥ / ) (% : / )  
[ ] mg °C . ( : / ) ( : / ) ( : / )  
/ mg (A. *transmontanus*) . ( : / )  
[ ]  
) /  
( (p≤ / ) (DFC) ( )  
(p≤ / ) %  
/ .(p≤ / )  
%  
% %  
( ) / / .(p≤ / )  
[ ] (p≤ / ) /  
( / )  
(p≤ / )  
(p≤ / ) / .(p≤ / )  
% .(p≥ / ) : /  
pH

[ ] ( )  
 (H. huso) g  
 % /  
 %  
 %  
 [ ]  
 [ ] ( )  
 [ ] ( )  
 (A. beari)  
 ( ) [ ] ±  
 .(p≤ / ) / /  
 / ( ) /  
 % ) ( )  
 [ ] ( %  
 Oncorhynchus .(P≤ / )  
 (Pleuronectes platessa) (tshawytscha)  
 (O.mykiss) .(p≥ / )  
 ( )  
 [ ] ( )  
 % /  
 /  
 .(p≥ / )  
 ( )

- 
1. Brenden
  2. Hung
  2. Kaushik
  3. Medale

[ ]

(p≤ / )

(p≤ / )

( / g± / )

( )

( / ± / )

% /

(% : / )

( : / )

( / ± / )

/ /

(p≤ / )

( / g± / )

(% : / )

( / ± / )

. /

(P≤ / )

( : / ) ( : / ) ( : / )

(*O.mykiss*)

%

%

(*Acipenser baeri*)

%

/ /

[ ]

g

)

(

[ ]

(NPU)

%

( )

%

: /

NPU

( )

(*Penaeus indicus*, Milne Edwards)

[ ]

( : / )

(*Ictalurus punctatus*)

( )

%

%

( )

(*O. mykiss*)

1. Protein sparing
2. Wilson & Poe
3. Hilton

( )

( : / ) ( : / ) ( : / ) ( : / )  
( : / ) ( : / )

)

( g

(H. huso)

- [1] Birstein V.; The sturgeon specialist group; Activities of the last triennium; 1996; p. 2.
- [2] Bronzi P., Rosenthal H., Arlati G., Williot P.; «A brief overview on the status and prospects of sturgeon farming in western and central Europe»; Proceeding of the 3rd International. Symp. on Sturgeon; *J. Appl. Ichthyology*. 15; 1999; 22: 224-27.
- [3] Lovell T.; Nutrition and Feeding of Fish; (second edition); Kluwer Academic Publisher (USA); 1998; 260 p.

» . [ ]

*P. indicus*

(Ph.D)

«

- [5] Moore J., Hung S. S. O., Medrano J.; «Protein requirement of hatchery–production juvenile white sturgeon, *A. trasmontanus*»; *Aquaculture*; 1988; 71: 235-245.

[ ]

» .

(*Huso huso*)

«

- [7] Grisdale-Helland B. S. J.; «Replacement of protein by fat and carbohydrate in diets of Atlantic salmon *Salmo salar* at the end of freshwater stage»; *Aquaculture*; 1997; 152: 167-180.
- [8] Nankervis L., Matthews S. J., Appleford P.; «Effect of dietary non – protein energy source on growth, nutrient retention and circulating insulin – like growth factor I and triiodothyronine levels in juvenile barramundi, *Lates calcarifer*»; *Aquaculture*; 2000; 191:323- 335.
- [9] Morais S., Bell J.G., Robertson D. A., Roy W.J., Morie P.C.; «Protein /lipid rations in extruded diets for Atlantic cod *Gadus morhua L.*: effects on growth, feed utilization, muscle composition and liver histology»; *Aquaculture*; 2001; 203: 101-119.
- [10] Black K., Pickering D.; Biology of farmed fish. Raton, flat: Sheffield; Academic Press; 1998; p.415

- [11] Hung S. S. O., Storebakken T.; «Carbohydrate utilization by rainbow trout is affected by feeding strategy»; *J. Nutr*; 1994; 124: 223-230.
- [12] Hung S. O. O., Storebakken T., Cui Y., Tian L., Einen O.; «High-energy diets for white sturgeon *A. transmontanus* Richardson»); *Aquaculture Nutrition*; 1997; 3: 281-286.
- [13] Page J. W., Andrews J. W.; «Interactions of dietary levels of protein and energy on channel catfish *Ictalurus punctatus*»); *Journal of Nutrition*; 1973 ; 103:1339-1346
- [14] Medale F., Blank D., Kaushik S. J.; «Studies on the nutrition of Siberian sturgeon, *A. baeri*.11. Utilization of dietary non-protein energy by sturgeon»); *Aquaculture*; 1991; 93:143-154.
- [15] Peragon J., Barroso J. B., Garcia-Salguero L., De La Higuera M., Lupianez A.; «Carbohydrates affect protein-turn over rates, growth and nucleic acid content in white muscle of rainbow trout *Oncorhynchus mykiss*»); *Aquaculture*; 1991; 179: 425-437.
- [16] Wilson R. P.; «Utilization of dietary carbohydrate by fish»); *Aquaculture*; 1994; 124: 67-80.
- [17] Christian B., Genyvie C., Medale F.; «Effect of dietary levels of carbohydrate and lipid on glucose oxidation and biogenesis from glucose in rainbow trout (*Oncorhynchus mykiss*), reared in freshwater or in seawater»); *Comp. Biochem. Physiol.* III A; 1995; 1: 117-124.
- [18] Hung S. S. O., Lutes P. B.; «Optimum feeding rate of hatchery-produced juvenile white sturgeon *A. transmontanus*: at 20-0C»); *Aqua*; 1987; 65: 307-317.
- [19] Amani G. N., Kamenan A., Sabate R. A., Colonna P.; «Stability of yam starch gels during processing»); *African Journal of Biotechnology*; 2004; 4: 94-101.
- [20] AOAC (Association of Official Analytical Chemists); Official methods of analysis.12th edn.; AOAC, Washington. DC; 1995.
- [21] Kofi F. A., Hung S.S.O., Liu W., Li H.; «Growth, lipogenesis and liver composition of juvenile white sturgeon fed different levels of D-Glucose»); *Aquaculture*; 1992; 105: 61-72.
- [22] Ronyai A., Peteri A., Radics F.; «Cross breeding of sterlet and Lena River's sturgeon»); *Aquaculture Hungrica* (Szarwas); 1990; 6:13-18.
- [23] Abdelghany A. E., Ahmad H. M.; «Effects of feeding rates on growth and production of Nile tilapia, common carp and silver carp polycultured in fertilized ponds»); *Aquaculture Research*; 2002; 33: 415– 423.
- [24] Hung L. T., Lazard J., Mariojouis and Moreau Y.; «Comparison of starch utilization in fingerlings of two Asian catfishes from the Mekong River *Pangasius bocourti* Sauvage,1880, *Pangasius hypophthalmus* Sauvage,1878»); *Aquaculture Nutrition*; 2003; 9: 215-222.
- [25] Wang S., Jian Liu S., Tian L. X., Quan Xie M., Yang H. J., Wang Y., Liang Ying G.; «Quantitative dietary lysine requirement of Juvenile grass carp *Ctenopharyngodon idella*»); *Aquaculture*; 2005; 249: 419-429.
- [26] Tacon T., Albert G. J.; «Standard methods for the nutrition and feeding of farmed fish and shrimp»); Argent Laboratones Press; 1990; pp: 4-27.
- [27] Hung S. S. O., Lutes P. B., Xu R.; «Ability of juvenile white sturgeon *A. transmontanus* to utilize different carbohydrate source»); *Journal of Nutrition*; 1989; 119: 272-733.
- [28] Hung S. S. O., Aikins K. F., Lutes P. B., Xu R.; «Ability of juvenile white sturgeon *A. transmontanus* to utilize different carbohydrate source»); *Journal of Nutrition*; 1989; 119: 272-733.
- [29] Hung S. S. O., Moore B. J., Bordner C. E., Conte F.S.; «Growth of juvenile white sturgeon *A. transmontanus* fed different purified diets»);

- Journal of Nutrition*; 1987; 117: 328-334.
- [30] Brendan J., Hung S. S. O., Mederano J.; «Protein requirement of hatchery-produced juvenile white sturgeon *Acipenser transmontanus*»); *Aquaculture*; 1988; 71: 235-245.
- [31] Kaushik S. J., Breque J., Blanc D.; «Requirement for protein and essential amino acids and their utilization by Siberian sturgeon *A. barei*»); Williot (editor) proceeding of the First International Symposium on Sturgeon, Cemegre, France, Publ; 1991; pp. 25-37.
- [32] Webster C. D., Lim C. E.; «Nutrient Requirement and Feeding of Finfish for Aquaculture»); *CABI International, CABI Publishing*; 2002; p. 418
- [33] Hilton J. W., Atkinson J. L.; «Response of rainbow *Oncorhynchus mykiss* to increased levels of available carbohydrate in practical trout diets»); *Br V Nutr*; 1982; 47: 597-607.
- [34] Bergot F.; «Effect of dietary carbohydrate and their mode of distribution on glycaemia in rainbow trout *Oncorhynchus mykiss*»); *Comp. Biochem. Physiol*; 1979; 64A: 543-547.
- [35] Dixon D. G., Hilton J. W.; «Influence of available dietary carbohydrate content on tolerance of waterborne copper by rainbow trout *Oncorhynchus mykiss*»); *Fish Biology*; 1981; 19: 509-517.
- [36] Wilson R. P., Poe W. E.; «Apparent inability of channel catfish to utilize dietary mono-and disaccharides as energy sources»); *Journal of Nutrition*; 1987; 117:280-285.
- [37] Hilton J. W., Atkinson J. L., Slinger S. J.; «Maximum tolerable level, digestion and metabolism D-glucose in rainbow trout (*Oncorhynchus mykiss*) reared on practical trout diet»); *Can. J. Fish Aquat. Sci*; 1982; 39:1229-1234.
- [38] Reinitz G., Hitzel F.; «Formulation of practical diets for rainbow trout based on desired performance and body composition»); *Aquaculture*; 1980; 19: 243- 252.
- [39] Brauge C., Corraze G., Medale F.; «Combined effects of dietary lipid/ carbohydrate ratio and environmental factors on growth and nutritional balance in Rainbow trout»); *world aquaculture-European Aquaculture Society*; 1993; 5: 26-28.
- [40] Brauge C., Corraze G., Medale F.; «Effect of dietary carbohydrate levels performance and glycemia in rainbow trout, reared in seawater»); *Aquaculture*; 1994; 123: 109-120.