MORPHOMETRIC CHARACTERISTICS, PROCESSING YIELDS AND FLESH COMPOSITION OF THREE SPECIES OF CULTURED STURGEON

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Background and Objectives: Italy is the major producer of sturgeon within the EU, the most important cultured species being *Acipenser transmontanus* (white sturgeon, AT), *Acipenser baeri* (Siberian sturgeon, AB) and *Acipenser naccarii* (Adriatic or Italian sturgeon, AN). This fish is sold under the general name of "sturgeon" with no reference being made to the different species. Hence, this study aims to characterize white sturgeon, Siberian and Adriatic sturgeon cultured in Italy on the basis of the most important morphometric measurements, the processing yields, flesh composition and muscle lipids in order to highlight any elements that may be of use to the farmer, processor or consumer in differentiating between these three species.
Methods: thirty sturgeon (10 AB, 10 AN, 10 AT, weight range 3.35÷5.70 kg, age range 42÷54 months) were obtained from an intensive commercial fish farm, where they had been maintained under uniform environmental conditions and feeding regimen. Freshly caught sturgeon whole in the round were immediately packed in crushed ice and transported to the laboratory of the institute, where they were weighed, measured and processed (see footnote c of Table 1 for processing variables).Three cross-sectional slices (6 cm each) were cut from each dressed carcass and weighed as a whole (untrimmed steak weight). Skin, bony scutes, subepithelial fat layers, dark muscle, cartilage and gut cavity lining were carved away and discarded. The three steaks thus obtained, containing white flesh only, were weighed (trimmed steak weight), finely diced and homogenized. The homogeneous sample mass prepared from each fish was analysed in duplicate for proximate composition, cholesterol content and fatty acid profile, while energy value was calculated. All data were subjected to one-way analysis of variance; where statistical differences were noted for a given trait, differences among species were determined using Duncan's *post hoc* multiple range test. Statistical significance was tested at the 0.05 probability level.
Results and Discussion: the data in Table 1 indicate that AT would be of superior commercial interest because of a greater somatic development coupled with a lower proportion of viscera and hence a higher eviscerated yield. The superiority of this species was noticeably reduced, however, when the dressed yield was taken into consideration, because of the higher proportion of head and tail. Nonetheless, AT regained first place when the steaks were trimmed, giving the highest white flesh yield. The three species of sturgeon showed noticeable differences as regards the chemical composition and energy value of the flesh (Table 2). The most striking difference emerged in lipid content: a 100 g serving of AT flesh would provide 6.7% of the daily fat intake di 67 g, currently recommended for an adult on a normocaloric diet with no more than 30% energy from fat. This percentage rises to 11.6 for AB and reaches 15.9 for AN, an aspect which is certainly of considerable interest for any health conscious consumer. As for the fatty acid profile (Table 3), the three species had in common the clear predominance of monounsaturated fatty acids (MUFAs), followed by saturated (SFAs) and polyunsaturated (PUFAs) fatty acids. AN had the highest content of MUFAs, while not differing from AT as regards SFAs. AB had the lowest content of SFAs and the highest content of n-6 and n-3 PUFAs, hence the highest peroxidizability index. This leads us to hypothesize that AB would be the most suitable species for fresh consumption (moderate fat amount, high n-3 PUFA content); on the other hand, AT flesh would probably be more successfully used for processing and storage (low fat content, low peroxidizability index).

Table 1 - Morphometric measurements, processing yields and muscle pH of the three species. [a,b]

Trait [c]	AB	AN	AT
Fork length (FL), cm	90.2y	91.4y	96.6x
Round weight (RW), g	4292y	4844x	4974x
Eviscerated weight (EW), g	3704y	4078xy	4399x
Dressed weight (DW), g	3112y	3473x	3628x
Untrimmed steak weight (USW), g	1089x	1167x	1201x
Trimmed steak weight (TSW), g	640y	639y	794x
Head (H), g	515.9y	532.8y	680.1x
Tail (T), g	63.6y	55.4y	83.7x
Viscera (V), g	522.5xy	628.4x	440.3y
Liver (L), g	127.1x	157.0x	116.4x
Pre-gonadal tissue (G), g	218.3x	231.9x	120.3y
Condition factor (CF)	0.58x	0.63x	0.56x
Eviscerated yield (EY), %	86.38y	84.23z	88.58x
Dressed yield (DY), %	72.57x	71.68x	73.02x
White flesh yield (WFY), %	58.04y	54.81z	64.66x
Head, %	12.03y	11.06z	13.70x
Tail, %	1.48y	1.15z	1.68x
Viscera index (VI)	12.06x	12.97x	8.80y
Hepato-somatic index (HSI)	2.95x	3.23x	2.36x
Gonado-somatic index (GSI)	4.96x	4.83x	2.38y
Muscle pH	6.10x	6.29x	6.15x

[a] AB= *Acipenser baeri*; AN= *Acipenser naccarii*; AT= *Acipenser transmontanus*. Values are means of 10 fish for each species.
[b] Means not followed by the same lower case letter are significantly different (P≤0.05).
[c] V is inclusive of L+G; CF=RW*100/FL^3; EY=EW*100/RW; DY=DW*100/RW; WFY=TSW*100/USW; Head %= H*100/RW; Tail %=T*100/RW; VI=V*100/RW; HSI=L*100/RW; GSI=G*100/RW.

Table 2 - Proximate composition, cholesterol content and energy value of muscle tissue (g/100g edible portion, unless otherwise noted).[a,b]

Trait	AB	AN	AT
Moisture	72.11y	69.81z	75.55x
Protein	19.47x	18.64y	19.57x
Lipid	7.76y	10.64x	4.49z
Ash	1.10x	1.02y	1.14x
Cholesterol, mg/100g	70.4x	64.8y	61.4y
Energy value, kcal/100g	148y	170x	119z

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[b] Means not followed by the same lower case letter are significantly different (P≤0.05).

Table 3 - Fatty acid composition of muscle lipids (% total fatty acid methyl esters).[a,b]

Trait[c]	AB	AN	AT
C14:0	3.96x	3.27y	3.62xy
C15:0	0.39x	0.31y	0.33y
C16:0	18.38z	20.91x	19.94y
C18:0	1.75y	1.60y	2.80x
C19:0	0.28x	0.25x	0.21y
ΣSFA	24.75y	26.34x	26.88x
C14:1	0.17x	0.16x	0.16x
C16:1n-7	7.14y	8.23x	5.83z
C18:1n-9	23.32y	28.17x	26.74x
C18:1n-7	2.82x	2.40y	2.27y
C20:1n-11	1.67x	1.35y	1.71x
C20:1n-9	5.55x	4.22z	4.96y
C22:1n-11	3.52x	2.68y	3.15xy
C22:1n-9	0.49x	0.30z	0.38y
C24:1	0.25x	0.18y	0.25x
ΣMUFA	44.89y	47.70x	45.39y
C18:2n-6 (LA)	3.86x	2.59z	2.89y
C18:3n-6	0.18x	0.14y	0.14y
C20:2n-6	0.29x	0.21y	0.23y
C20:3n-6	0.13x	0.11y	0.13x
C20:4n-6 (AA)	0.84x	0.54y	0.88x
ΣPUFA n-6	5.23x	3.51z	4.18y
C18:3n-3 (ALA)	0.79x	0.68y	0.62y
C18:4n-3	1.25x	1.19xy	1.01y
C20:5n-3 (EPA)	6.54x	4.81z	5.55y
C21:5n-3	0.29x	0.25y	0.25y
C22:5n-3	1.42x	0.97z	1.14y
C22:6n-3 (DHA)	9.70x	8.77x	9.06x
Σ PUFAn-3	19.98x	16.66y	17.62y
ΣPUFA	25.21x	20.17y	21.81y
ΣUFA	70.10x	67.87y	67.20y
SFA/UFA	0.35y	0.39x	0.40x
n-3/n-6	3.83z	4.74x	4.21y
PEROX. INDEX	142.73x	118.94y	127.57y

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[b] Means not followed by the same lower case letter are significantly different (P≤0.05).
[c] SFA= saturated fatty acid; MUFA= monounsaturated fatty acid; LA= linoleic acid; AA= arachidonic acid; PUFA= polyunsaturated fatty acid; ALA= α-linolenic acid; EPA= eicosapentaenoic acid; DHA= docosahexaenoic acid; UFA= unsaturated fatty acid; peroxidizability index= (0.025∗monoenes) + (1∗dienes) + (2∗trienes) + (4∗tetraenes) + (6∗pentaenes) + (8∗hexaenes).